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July 21, 2020

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Subject: Final 2018 Annual Performance and Effectiveness Monitoring Report
Pole Canyon NTCRAs, Smoky Canyon Mine

Dear Art,

This submittal by J.R. Simplot Company provides the *Final 2018 Annual Performance and Effectiveness Monitoring Report (PEMR) for the Pole Canyon Non-Time-Critical Removal Actions (NTCRAs)*, as approved on July 8, 2020. The title page has been revised to reflect submittal of the final version of the report. The full hardcopy of this report is submitted to the Forest Service, a CD is provided to Bureau of Land Management (BLM), and an electronic copy is provided to rest of the distribution list.

Please contact me if there are questions regarding this submittal.

Sincerely,

Jeffrey Hamilton
Environmental Engineer

cc: (1 copy except as otherwise noted)
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FINAL

2018 Annual Report
Pole Canyon Non-Time-Critical Removal Actions
Performance and Effectiveness Monitoring

Smoky Canyon Mine
July 2020

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%	percent
ASAOC	Administrative Settlement Agreement and Order on Consent/ Consent Order
BLM	United States Department of Interior Bureau of Land Management
cfs	cubic feet per second
cm/sec	centimeters per second
EDS	Energy Dissipation Structure
EMP	Effectiveness Monitoring Plan
F	Fahrenheit
gpm	gallons per minute
HDPE	High-Density Polyethylene
HELP3	Hydrologic Evaluation of Landfill Performance
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
Ks	Saturated Hydraulic Conductivity
lbs	pounds
lbs/day	pounds per day
Mine	Smoky Canyon Phosphate Mine
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NTCRA	Non-Time-Critical Removal Action
ODA	Overburden Disposal Area
O&M	Operations and Maintenance
PEMR	Performance and Effectiveness Monitoring Report
PRSC	Post-Removal Site Control
Rev	Revision
SNOTEL	Snow Telemetry
Tribes	Shoshone-Bannock Tribes
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Department of Agriculture Forest Service
USFWS	United States Department of Interior Fish and Wildlife Service

1.0 INTRODUCTION

This 2018 Performance and Effectiveness Monitoring Report (PEMR) presents the results of the annual performance and effectiveness monitoring activities for the Pole Canyon Overburden Disposal Area (ODA) Non-Time-Critical Removal Actions (NTCRAs) implemented at the J.R. Simplot Company (Simplot) Smoky Canyon Phosphate Mine (Mine). The Mine is located approximately 24 miles east of Soda Springs in Caribou County, Idaho (Figure 1-1).

1.1 Pole Canyon ODA Non-Time-Critical Removal Actions

The Pole Canyon ODA at the Smoky Canyon Mine is a cross-valley fill consisting of run-of-mine overburden (waste rock containing seleniferous shales) covering approximately 120 acres of lower Pole Canyon, including the original Pole Canyon Creek channel (Figure 1-2). Most of the overburden in the Pole Canyon ODA originated from Panel A, which was mined from 1985 until 1990. A much smaller portion of the ROM material came from Panel D and was placed on the west side of the ODA in 1997. Reclamation of portions of the Pole Canyon ODA took place in 1989 and 1990, and again in the late 1990s.

Two NTCRAs have been implemented at the Pole Canyon ODA. The first, the Pole Canyon Water Management NTCRA (2006 NTCRA), was implemented in accordance with the Administrative Settlement Agreement and Order on Consent/Consent Order (ASAOC) entered into by the United States Department of Agriculture (USDA) Forest Service (USFS), United States Environmental Protection Agency (USEPA), Idaho Department of Environmental Quality (IDEQ), and Simplot (USFS, USEPA, and IDEQ 2006). The second, the Pole Canyon Dinwoody/Chert Cover NTCRA (2013 NTCRA), was implemented under a separate ASAOC entered into by the USFS, IDEQ, the Shoshone-Bannock Tribes (Tribes), and Simplot (USFS, IDEQ, and Tribes 2013).

The USFS is the Lead Agency for conducting response actions at the Site. Collectively, the Agencies involved in lead or support roles for one or both of these NTCRAs, including the USFS, USEPA, IDEQ, Bureau of Land Management (BLM), United States Fish and Wildlife Service (USFWS), and the Tribes, are referred to in this report as the “Agencies.”

1.1.1 2006 NTCRA

The general objectives of the 2006 NTCRA were addressed by three major construction components (Figure 1-2):

- Bypass pipeline to convey diverted Pole Canyon Creek flow around the Pole Canyon ODA.

- Infiltration basin to direct the upstream Pole Canyon Creek flow, between the bypass pipeline inlet and the ODA along with creek flows in excess of the pipeline capacity, into the Wells Formation aquifer on the upstream side of the ODA.

- Run-on control channel adjacent to the northern edge of the ODA to direct run-on from the adjacent slopes into Pole Canyon Creek downstream of the ODA.

Construction of the bypass pipeline and the infiltration basin was completed in 2007, and the run-on control channel was completed in 2008.

Bypass Pipeline – The bypass pipeline conveys surface water via gravity flow from the uppermost 615 acres (approximately 60 percent) of the upper Pole Canyon Creek watershed around the ODA and discharges this water back into the creek channel below the ODA. The creek flows into the pipeline via an inlet structure that is designed to prevent sediment and debris from entering the pipeline. If the creek flow is greater than the pipeline capacity (44 cubic feet per second [cfs]), the excess water flows down the original creek channel to the infiltration basin directly upstream (west) of the ODA.

Locations of the concrete inlet and outlet structures are shown on Figure 1-2. Total length of the bypass pipeline is approximately 10,400 feet between the inlet and outlet. The pipeline is constructed of 32-inch outside diameter, smooth walled high-density polyethylene (HDPE) pipe and is buried between 5 and 15 feet below ground surface along the entire length. Access points (manholes) are present approximately every 1,000 feet. The outlet structure is located approximately 1,000 feet downstream of the toe of the Pole Canyon ODA and consists of a concrete outfall with a concrete baffle block for energy dissipation to limit scour and erosion of the stream channel below the outfall. Pipeline flow is monitored continuously at the inlet and outlet structures with weirs, pressure transducers, and data loggers.

Infiltration Basin – The infiltration basin captures runoff from approximately 487 acres (40 percent) of the upper Pole Canyon Creek watershed between the bypass pipeline diversion inlet and the upstream toe of the ODA. During infrequent, unusually wet years, excess flows bypass the diversion system and the water is stored temporarily in the infiltration basin and then infiltrates into the underlying Wells Formation. Under normal operating conditions, water does not pond in the infiltration basin.

The storage capacity of the infiltration basin was determined based on elevation data from the construction as-built information, with a minimum basin floor elevation of 7,175 feet. A 5-foot contour interval was used in the average end-area calculations, resulting in storage of 1.3 acre-feet at a water depth of 5 feet and 51 acre-feet at a water depth of 45 feet (Formation 2012b). The maximum storage volume corresponds to the elevation contour matching the top of the synthetic liner on the west-facing slope of the ODA.

The infiltration basin was constructed on Wells Formation bedrock directly upstream of the ODA by scraping the alluvial material off and blasting the Wells Formation to create a permeable basin floor. A synthetic liner was installed on the east side of the basin on the west-facing slope of the ODA, from the basin floor to a height of approximately 45 feet, to prevent movement of water from the basin directly into nearby overburden (NewFields et al. 2009) in the unusual condition in which the pipeline capacity of 44 cfs is exceeded. Flow along upper Pole Canyon Creek has not exceeded pipeline capacity since continuous flow monitoring of the pipeline began.

A sedimentation basin was constructed directly upstream of the infiltration basin to limit the amount of sediment entering the infiltration basin that could ultimately reduce the rate of infiltration through the basin floor over time. A flume, pressure transducer, and data logger were installed within the creek channel directly upstream of the sedimentation basin at monitoring location UP-IN in early 2009 to monitor creek flow entering the infiltration basin.

Run-On Control Channel – The run-on control channel intercepts runoff from an upslope area of approximately 95 acres on the hillside adjacent to the ODA to the north and diverts the water around the ODA and back to the Pole Canyon Creek channel below the ODA in order to prevent water from contacting overburden material. The run-on control channel was designed to intercept and convey the runoff generated by a 100-year, 24-hour storm event (NewFields 2009). Total length of the run-on control channel is approximately 1,135 feet. The upper portion of the channel is relatively low gradient and is lined with turf reinforcement mat to limit erosion during high-flow events. The lower portion of the run-on control channel is a relatively steep chute that drops down the north hillside adjacent to the east face of the Pole Canyon ODA and is armored with articulated concrete block panels to limit erosion due to potentially high flow velocities in this portion of the channel.

1.1.2 2013 NTCRA

The general objectives of the 2013 NTCRA were addressed by two construction components (Figure 1-3):

- Dinwoody/Chert cover system to reduce or eliminate the amount of water that infiltrates into the ODA due to direct precipitation, reduce or eliminate the potential for ecological risk due to ingestion of vegetation on the ODA, and reduce or eliminate the potential for risk to human receptors due to ingestion of vegetation and ingestion of and direct contact with ODA materials.

- Storm water run-on/runoff controls to eliminate the release of contaminants from the ODA via sediment transport.

Construction of the cover system and storm water controls was completed in 2015, with minor follow-up construction performed in 2016.

Dinwoody/Chert Cover System – The Dinwoody/Chert cover system consists of a 3-foot-thick layer of fine-to-medium grained Dinwoody material with some gravel overlying a 2-foot-thick gravel chert layer that was designed with a saturated hydraulic conductivity (Ks) of $1x10^{-4}$ centimeters per second (cm/sec) or less. The cover was revegetated with native non-selenium-accumulating species to control erosion and facilitate evapotranspiration. A portion of the east-side top area of the ODA contains a gravel-covered zone used by Simplot as a blast compound and miscellaneous equipment storage area. Gravel road base was placed over the soil cover to provide an adequate driving surface in that area.

Storm Water Run-on/Runoff Controls – Run-on and runoff controls are comprised of ditches, channels, chutes, berms, swales, culverts, and associated energy dissipation structures (EDS) that capture and collect flows from adjacent, topographically higher areas and convey the flows around the Pole Canyon ODA (Figure 1-3). Captured runoff from the ODA is conveyed to one of several sedimentation basins. Water conveyance features were designed for a 100-year, 24-hour storm event, and water retention features were designed for a 2-year, 24-hour storm event.

1.2 Monitoring Objectives and Purpose of Report

The purpose of this 2018 Annual Performance and Effectiveness Monitoring Report is to provide the Agencies with the performance evaluation results, effectiveness monitoring results, and the effectiveness evaluation for the 2006 NTCRA and 2013 NTCRA in one combined annual report.

Performance monitoring and operation and maintenance (O&M) requirements include:

- Semiannual inspections of the 2006 and 2013 NTCRA to verify that the components are performing as designed and to identify any maintenance or repair needed.

- Annual maintenance to provide for long-term performance and integrity of the NTCRA components.

Effectiveness monitoring includes:

- Surface water monitoring at LP-1 (seepage from the downstream toe of the ODA), lower Pole Canyon Creek station LP-PD, North Fork Sage Creek stations NSV-5 and NSV-6, and LSV-1 (below confluence of Sage Creek but above the confluence of Hoopes Spring), as well as two key locations upstream of the ODA – at UP-PD (upstream of the pipeline inlet) and UP-IN (upstream of the infiltration basin) to assess the effectiveness of the NTCRAs in decreasing selenium transport from the Pole Canyon ODA to surface water.

- Groundwater monitoring locations in alluvium (GW-15, GW-22, and GW-26) and in the Wells Formation (GW-16) that are downgradient of the Pole Canyon ODA but upgradient of potential transport pathways from other source areas to assess the effectiveness of the 2006 and 2013 NTCRAs in decreasing selenium transport from the ODA to groundwater.

- Vegetation monitoring at six locations (Zones 1 through 6) on the Pole Canyon ODA Dinwoody/Chert cover system to evaluate the effectiveness of the 2013 NTCRA in reducing or eliminating risks due to ingestion of vegetation growing on the cover.

1.3 Report Organization

This Performance and Effectiveness Monitoring Report is organized as follows:

Section 2	Summary of inspections and maintenance/repair actions and discussion of pipeline flow evaluation
Section 3	Description of effectiveness monitoring activities and presentation of effectiveness monitoring results
Section 4	Presentation of statistical analysis results, water-balance and mass-balance results, and selenium concentrations in vegetation
Section 5	Summary of performance evaluation and effectiveness monitoring results
Section 6	References cited.

2.0 PERFORMANCE EVALUATION

Performance evaluation for the bypass pipeline, infiltration basin, and run-on control features is conducted in accordance with the *Pole Canyon Water Management Removal Action Post-Removal Site Control Plan* (2006 NTCRA PRSC Plan) (NewFields 2009). The 2013 NTCRA Dinwoody/Chert cover system is evaluated as per the *Pole Canyon Overburden Disposal Area 2013 Non-Time-Critical Removal Action Post-Removal Site Control Plan* (2013 NTCRA PRSC Plan) (Formation 2016). The performance evaluation activities completed in 2018 for the 2006 NTCRA and the 2013 NTCRA included formal and informal inspections, and maintenance and repair actions. Additionally, a bypass pipeline inflow and outflow comparison was performed for the 2006 NTCRA.

2.1 Inspections

There were no weather or seismic events in 2018 large enough (e.g., 100-year, 24-hour storm event with 2.9 inches of precipitation or seismic event greater than or equal to magnitude 6) to trigger an immediate inspection of the NTCRA components, based on guidelines in the 2006 NTCRA PRSC Plan and the 2013 NTCRA PRSC Plan (NewFields 2009; Formation 2016). Also, no logging, forest fires, or development activities occurred that would trigger additional inspections.

Two formal inspections were completed in 2018 for the 2006 NTCRA, one on April 30 and another on October 22, to meet the requirement for semiannual spring and fall inspections. Two formal inspections of the 2013 NTCRA were completed on June 6 and November 6. Inspection forms and photographs that document the condition of the NTCRA components and identify maintenance/repairs needed and maintenance procedures implemented are provided in Appendix A. No photographs are available for the spring inspection of the 2006 NTCRA. During the fall inspection of the 2013 NTCRA, Simplot and Agency personnel reviewed items that were repaired during the spring and summer months and therefore an inspection form was not completed. Photographs documenting the repairs are included in Appendix A. Several informal inspections were completed during the course of the year when Mine personnel were in the vicinity of the Pole Canyon ODA for other activities. Information from the inspections and maintenance/repairs conducted are summarized in the following sections.

2.1.1 Spring Inspection – 2006 NTCRA

Inspection of the bypass pipeline including the inlet and outlet structures, sedimentation basin and infiltration basin, and run-on control channel for the 2006 NTCRA was performed by Evan Hathaway (Simplot) on April 30, 2018.

Inspection of the pipeline alignment, including access points and vents, found that it was in good condition (Appendix A). No areas requiring maintenance or repair were identified.

Inspection of the bypass pipeline inlet structure found that it was in good condition with only minor repair required. The concrete was stable and free of cracks. Some sediment/debris and moss were observed on the grizzly screen. The debris was removed, and the sediment flushed at the time of the inspection. Some flow along upper Pole Canyon Creek was observed flowing beneath the inlet structure concrete through a minor piping failure that was in need of patching. Water was flowing evenly over the weir notches. Riprap upstream of the pipeline inlet was in good condition, indicating that the rock remained stable as protection against channel erosion in this reach of upper Pole Canyon Creek.

Inspection of the pipeline outlet dissipation structure, discharge weir, and staff gage found that they were generally in good condition. The concrete was stable and free of cracks. No sediment was present in the invert. The steel discharge weir was in good condition but appeared to be bowed outward (the bowing was minimal and has been noted in previous inspections). The staff gage and data logger were in good condition and the data logger was operating correctly.

Inspection of the sedimentation basin, spillway, and infiltration basin found that the basins were in good condition. The spillway contained no sediment and there was no displacement of any of the riprap due to high-flow events. Minimal sediment was observed in the sedimentation basin. Vegetation was well established adjacent to the basin and was observed filling in within the basin. No signs of depressions or sinkholes were observed at the time of inspection. Minimal erosion was evident at the edges of the infiltration basin.

Inspection of the run-on control channel found that it was in good condition with no maintenance or repair required. Vegetation was established along the channel. No water was present within any portion of the run-on control channel, minimal sediment had accumulated in the sedimentation basin and downstream channel, and no debris was present in the channel. Minimal erosion was observed along the steep chute of the channel.

2.1.2 Spring Inspection – 2013 NTCRA

The spring inspection of the cover system, access roads, drainage control features, sedimentation basins, and reclaimed borrow area for the 2013 NTCRA was performed by Jeff Hamilton (Simplot), Ron Quinn (Simplot), Andrew Herrera (Simplot), and Art Burbank (USFS) on June 6, 2018. Weather conditions during the spring inspection were sunny and the cover system, drainage control features, and sedimentation basins were free of snow.

Inspection of the cover system found that it was generally in good condition (Inspection Form 1, Appendix A). Some small localized rills were observed on the west-side cover system in the upper west-side area. Slumping observed in the south-central area in 2017 was inspected and vegetation in the localized slump was slow to come in. Minor to moderate rilling was observed on the east-side cover system in several areas including the top east area, south east-side slope and the upper and middle east-side slopes (see Inspection Form 1). Water was also observed pooling on the top east area. Minor erosion was observed in the south east seep zone. Maintenance was identified as being required in these areas. Maintenance (grading) had already been performed to address erosion of the access road on the middle east-side slope. Temporary erosion-control features were generally in good condition and prevented rill development on cover slopes. Additional vertical wattles were needed on the upper east-side slope and wattles on the south east-side slope needed to be reseeded. Silt fences were in good condition with minimal maintenance or repairs required. Vegetative growth appeared generally in good condition although some areas appeared to be slow to establish. These areas were identified to be revisited later in the growing season to determine if they required reseeding.

The inspection found that the west-side cover drainage control features were generally in good condition with maintenance or repairs needed in some areas (Inspection Form 2, Appendix A). Minor sedimentation was observed in the west EDS and was identified as needing removal as part of regular O&M. The run-on and runoff ditches were generally in good condition. Minor erosion and sedimentation were observed in the south runoff ditch to the west-side south sedimentation basin and the discharge ditch from the west-side south sedimentation basin.

The east-side cover drainage control features were in good condition (Inspection Form 3, Appendix A). The east-side haul road runoff system was in good condition. Vegetation was established, no water was present within any portion of the channels/ditches, no erosion or sedimentation was observed, and the turf reinforcement mat, riprap, and grouted riprap were in good condition with no signs of cracking or removal by high flows. Inspection of the east EDS revealed that a moderate amount of sediment had accumulated in the dissipation structure and was identified for removal as part of regular O&M. A silt fence observed in the discharge ditch from the east sedimentation basin was also identified for removal.

The sedimentation basins, including pipe outlets and spillways, on both the west-side and east-side covers were in good condition (Inspection Forms 4 and 5, Appendix A). No cracks, sloughing, or other stability issues were observed in the sedimentation basins and pipe outlets and spillways. No erosion was observed. Water was observed within the west sedimentation basin at a depth of about 2 feet. Minimal sediment was observed along the edge of the west-side south and northwest sedimentation basins. Spillways were generally free of debris. The access road to the west sedimentation basin was identified for repairs. A minor amount of water was observed in one end of the south-central sedimentation basin and about 1-½ feet of water was observed within the saddle basin. The sediment depth was not measured and infiltration into the 2nd cell was estimated at 1-½ feet. No water and only a minor amount of sediment were observed within the east sedimentation basin. Vegetation growth around the sedimentation basins was generally well established, and in the saddle sedimentation basin the vegetation was not established but was coming in.

The Dinwoody borrow area and associated run-on ditches and sedimentation basins were in good condition, with only minor maintenance needed (Inspection Form 6, Appendix A). The wattles in the north closure area needed some work as part of regular O&M. No signs of instability, erosion, or sedimentation were observed in the ditches and sedimentation basins. In the ditches, no debris was present, and the turf reinforcement mat was in good condition. A water depth of approximately 1 to 3 feet was present in the north and south sedimentation basins. The access road on the north side was in good condition; however, some minor rills were evident on the south access road. Vegetation was minimal in the north sedimentation basin and was coming in but still sparse in the south sedimentation basin. Vegetation growth in the north and south borrow areas was well established.

2.1.3 Summer Maintenance and Repair Actions

Maintenance and repair actions were identified during the spring 2018 inspection of the 2006 NTCRA water management components and the 2013 NTCRA Dinwoody/Chert cover system components. Photographs of items undergoing maintenance and repair actions are included in Appendix A (Pipeline Inlet Repair, Pole Canyon 2006 NTCRA; Fall Inspection, Pole Canyon 2013 NTCRA). The following repair/maintenance actions took place in 2018:

- A minor piping failure allowing water to flow beneath the bypass pipeline inlet structure of the 2006 NTCRA was filled with approximately 100 pounds (lbs) of bentonite and armored with riprap to prevent further bypass of flow beneath the infiltration structure.
- The upper west-side access road was graded, and erosion was repaired.
- Rills along the upper west-side slope and lower west-side slope were repaired and smoothed out and the slope and rills and wattles were reseeded to reduce water flowing onto wattles to the east.
- The top east area on the east-side cover system was reseeded and fertilized.
- The blast compound area on the east-side cover system was regraded to promote positive drainage and reduce the ponded areas that formed after rainfall and snowmelt events.
- Due to some rilling, wattles along the south east-side slope were reseeded.
- Rills along the upper east-side slope were smoothed out and repaired. Additional wattles were installed and seeded, and hydromulch was placed on the slope to reduce the potential for erosion.
- Rilling on the middle east-side slope approximately 50 feet north of the chute to the EDS was repaired.
- The access road on the middle east-side slope of the east-side cover system was graded to reduce erosion.
- Sediment was cleared from the west EDS, west sedimentation basin, and east EDS as part of routine O&M.
- A silt fence was removed from the east sedimentation basin discharge ditch.
- Erosion on the access road to the west sedimentation basin was repaired and water bars were built on the road.

- Wattles were reinstalled and reseeded in the north Dinwoody borrow area.
- Noxious weed control was performed and targeted species including musk thistle, Canada thistle, spear thistle, and houndstongue. Milestone® at 15 gallons per acre and was applied with backpack sprayers and/or a truck-hose/handgun.

2.1.4 Fall Inspection – 2006 NTCRA

The fall inspection of the bypass pipeline including the inlet and outlet structures, sedimentation basin and infiltration basin, and run-on control channel for the 2006 NTCRA was performed by Evan Hathaway (Simplot) and Len Mason (Formation) on October 22, 2018. It was sunny and cool to warm during the fall inspection.

Inspection of the pipeline alignment, including access points and vents, found that it was in good condition (Appendix A). No erosion was noted and no areas requiring maintenance or repair were identified. Vegetation growth along the pipeline was acceptable. No areas of settlement or saturation were observed that would be indicative of pipeline leakage.

Inspection of the bypass pipeline inlet structure found that it was in good condition and free of sediment. The concrete was stable and free of cracks and the grizzly was clear. Water was flowing evenly over the weir notches. Riprap in the channel upstream of the inlet to the bypass pipeline was in good condition, indicating that the rock remained stable as protection against channel erosion in this reach of upper Pole Canyon Creek. A minor piping failure between the riprap and the grizzly that had been patched during summer maintenance to limit infiltration were in good condition. Inspection of the outlet structure found that it was in good condition with no maintenance or repair required. Some sediment was observed in the invert and vegetation growth around the structure was considered acceptable.

The sedimentation basin, spillway, and infiltration basin were in good condition. Some sediment was observed above the water line in the sedimentation basin. The spillway contained no sediment and there was no displacement of any of the riprap due to high-flow events. The infiltration basin had no standing water, and no depressions or sinkholes were evident. Some fine sediment was observed in the infiltration basin. Rock placed around the upstream edge of the flume (UP-IN) appeared to be stable.

Inspection of the run-on control channel found that it was in good condition. Vegetation growth along the channel was fairly well established and minimal side hill inflows were observed. No water was present within any portion of the run-on control channel, and minimal sediment and debris was present in the sedimentation basin and in the downstream channel. Vegetation growth along the embankments of the channel was considered acceptable. Minimal erosion was observed at the outfall and in the dissipation basin.

2.1.5 Fall Inspection – 2013 NTCRA

The fall inspection of the cover system, access roads, drainage control features, sedimentation basins, and reclaimed borrow area for the 2013 NTCRA was performed by Andrew Herrera (Simplot), Jeff Hamilton (Simplot), Ron Quinn (Simplot), and Art Burbank (USFS) on November 6, 2018. The ground was covered with snow during the inspection. The objective of the fall inspection was to revisit and inspect areas where repairs were made earlier in the spring/summer as well as to identify any outstanding issues.

Due to snow cover during the inspection, it was determined that completion of the PRSC checklist was not necessary. The inspection found the repaired items in overall good condition and the 2013 NTCRA components performing as designed. Vegetative growth in areas identified during the spring 2013 NTCRA inspection as areas to be revisited later in the growing season were not inspected due to the snow cover. These areas were reseeded and fertilized prior to snow fall.

2.1.6 Informal Inspections

Simplot and Formation personnel visited the pipeline inlet/outlet structures at various times in 2018 during routine surface water and groundwater sampling and when data were downloaded from data loggers installed at the flumes, weirs, and/or groundwater monitoring wells. Informal inspections of NTCRA components during these visits typically involved visual observations to assess the performance of the components relative to the design and occasionally involved minor “housekeeping” or maintenance activities.

Telemetry data indicated that the transducers at both the inlet and outlet had frozen during January 2018. An informal inspection was performed on March 29, 2018 to investigate the conditions. Stage along upper Pole Canyon Creek was very low and not entering the pipeline. A minor piping failure was observed, and the creek was flowing beneath the inlet structure. All flow not entering the pipeline eventually entered the infiltration basin. As stage in upper Pole Canyon Creek rose during spring runoff, flow began reentering the pipeline, as indicated by the telemetry data. These conditions were confirmed during an informal inspection on April 17 (see photos in Appendix A), and only minimal flow (approximately 1 to 2 gallons per minute [gpm]) were observed flowing beneath the concrete. Manual stage readings at UP-PD and LP-PD confirmed that flow at the pipeline inlet and outlet were equal. As described in Section 2.1.3, the piping failure was plugged with approximately 100 lbs of bentonite on July 12, 2018.

2.2 Pipeline Flow Evaluation

The bypass pipeline captures streamflow from approximately 615 acres of the upper Pole Canyon Creek watershed and discharges this flow downgradient of the ODA (Figure 1-2). The flow through the bypass pipeline is measured continuously at both the inlet (UP-PD) and the outlet

(LP-PD) using permanent weirs outfitted with pressure transducers and data loggers. Further, telemetry equipment has been installed at both the inlet and outlet, which allows transmission of continuous flow data throughout the year even when the inlet and/or outlet locations are inaccessible. Details on the measurement methods at the pipeline inlet and outlet are provided in Appendix B.

A comparison of flow rates measured at these two locations is shown in Figure 2-1. Also, the cumulative flows for UP-PD and LP-PD and the relative differences between their cumulative flows for 2018 are shown. Only a limited amount of pipeline flow data is available for 2018. A review of telemetry data indicated that the transducers began icing up and recording erroneous data. As discussed in Section 2.1.6, these conditions were confirmed during an informal inspection on March 29, 2018. Water along upper Pole Canyon Creek was flowing beneath the inlet structure due to a minor piping failure and due to the low stage at the time, flow was not entering the pipeline. As the stage in upper Pole Canyon Creek increased, flow through the pipeline resumed on April 5, 2018 and flow data is available for LP-PD (as shown on Figure 2-1). The inlet transducer was damaged during the winter, likely as a result of ice buildup, and continuous flow data for UP-PD is not available until the transducer could be replaced on May 30, 2019. However, manual stage readings at UP-PD and LP-PD confirmed that flow at the pipeline inlet and outlet were equal.

The 2018 peak flow rate for LP-PD was measured at approximately 4.7 cfs on May 10, 2018. Flow data for this date is not available at UP-PD; however, a flow rate of 3.6 cfs was manually measured at UP-PD on May 18, 2018. Approximately 400 acre-feet of water passed through the bypass pipeline, with the majority of pipeline flow occurring before July. A comparison of cumulative flow volume (for the period where data is available for both stations) shows a small difference of about 3 percent at the end of 2018. With the exception of 2010, the annual cumulative flow difference was a positive value (i.e., a higher measured flow at the pipeline outlet), indicating that there is no leakage from the pipeline.

The difference in estimated flows may be due to a combination of factors related to measurement. Historically, the greatest difference in flow appears to occur during high-flow conditions. Discharge at the pipeline outlet (LP-PD) appears to surge and back up behind the weir, potentially causing a slightly biased-high reading. Additionally, differences may include possible instrument drift at UP-PD and/or LP-PD. Manual flow measurements are periodically collected to check the transducer readings and correct for instrument drift. Evaluation of flow monitoring data is ongoing, with possible correction of flow measurements based on new information.

3.0 MONITORING ACTIVITIES AND RESULTS

Effectiveness monitoring for the NTCRAs is conducted in accordance with *Pole Canyon Non-Time-Critical Removal Action Effectiveness Monitoring Plan Revision No. 5* (EMP Rev 5; Formation 2018). The specific objectives of the effectiveness monitoring program are to assess the overall effectiveness of the 2006 and 2013 NTCRAs in reducing the rate of selenium transport from the Pole Canyon ODA to surface water in Pole Canyon Creek and downstream in Sage Creek, to shallow alluvial groundwater underlying the ODA and to deeper Wells Formation groundwater, and in reducing selenium concentrations in vegetation growing on the ODA cover system. Effectiveness monitoring includes meteorological, surface water, groundwater, and vegetation monitoring. Field activities are described for each monitoring type followed by a summary of the monitoring results.

3.1 Meteorological Monitoring

Monthly meteorological monitoring data were collected at the Site as specified in EMP Rev 5 (Formation 2018). A description of the field activities that were conducted and the precipitation data obtained, including any deviations from the specifications in EMP Rev 5, is presented below. Although it was not a specific requirement of EMP Rev 5, daily temperature data were compiled for use in the Hydrologic Evaluation of Landfill Performance (HELP3) Model.

3.1.1 Precipitation

Monthly precipitation data for 2004 through 2018, average monthly, and average annual precipitation amounts for the last 15 years are summarized in Table 3-1. Annual precipitation amounts are provided for the period from December 1 of the previous year through November 30 to account for snow accumulation in the winter season. The cumulative precipitation for 2018 is plotted in Figure 3-1, as well as the maximum, minimum, and average annual cumulative precipitation from 2004 through 2018.

In general, monthly precipitation amounts in 2018 were lower than average and were similar to conditions in 2013 and 2015. The annual precipitation for 2018 (December 1, 2017 through November 30, 2018) was approximately 21 inches, compared to an average annual precipitation of 24 inches for the past 15 years. Most of the precipitation occurred as snowfall from February through April before and during spring runoff. Drier than normal conditions were recorded during the summer months from July through September with less than 2 inches of precipitation. Following greater than average rainfall in October, precipitation was below average again in November.

3.1.2 Temperature

Daily temperature measurements collected at the Slug Creek Divide Snow Telemetry (SNOTEL) station were used in HELP3 modeling to assess infiltration through the Pole Canyon ODA cover. Figure 3-1 compares the average daily temperature for 2018 (December 1, 2017 through November 30, 2018) to long-term average daily maximum and minimum temperatures and long-term monthly average temperatures. The period for long-term calculations for the HELP3 model is 1989-2018.

Daily average temperatures are typically below freezing from November through March. In 2018, January through March temperatures were generally within the range of the long-term daily minimum and maximum temperatures. The maximum daily average, 70 degrees Fahrenheit (F), occurred August 11, 2018. The minimum daily average, 4 degrees F, occurred February 21, 2018.

3.2 Surface Water

Effectiveness monitoring activities were performed, and data were collected at the monitoring locations specified in EMP Rev 5 (Formation 2018). These locations are used for the effectiveness evaluation because they are affected only by the Pole Canyon ODA source.

The following monitoring activities are described:

- Continuous surface water flow monitoring at UP-IN, UP-PD, LP-1, and LP-PD

- Semiannual flow monitoring of surface water upstream and downstream of Pole Canyon Creek at NSV-5 and NSV-6

- Semiannual water-quality monitoring of surface water upstream and downstream of the NTCRAs at UP-IN, UP-PD, LP-PD, LP-1, NSV-5, and NSV-6

- Three times a year (spring, summer, and fall) flow and water-quality monitoring of surface water in lower Sage Creek upstream of Hoopes Spring at LSV-1.

Surface water effectiveness monitoring locations are shown on Figure 3-2 and sample dates are listed in Table 3-2. A description of the field activities that were conducted and the monitoring results obtained, including any deviations from the specifications in EMP Rev 5, is presented below. Methods for evaluating continuous flow measurements are provided in Appendix B. Electronic data files are included as Appendix C.

3.2.1 Field Activities

Surface water flow was measured at all seven monitoring locations in May 2018 to characterize high-flow conditions associated with spring runoff (Table 3-3). Flow was measured at LSV-1 in August 2018 to evaluate the surface water transport pathway in lower Sage Valley upstream of Hoopes Spring. Flow was measured at six of the seven locations in October 2018 to characterize low-flow conditions. Due to low water in North Fork Sage Creek, flow was not measured at NSV-5 in October. Flow measurements at stations LSV-1, NSV-5, and NSV-6 were made or attempted using the area-discharge method. Flows at the other locations were monitored on a continuous basis using Parshall flumes installed at monitoring stations UP-IN and LP-1, and weirs at the bypass pipeline inlet (UP-PD) and outlet (LP-PD). Details on the measurement methods are provided in Appendix B.

Semiannual surface water quality samples were collected at all seven monitoring locations specified in EMP Rev 5 (Formation 2018) in May and October 2018 (Table 3-2). Two of these locations (UP-PD, UP-IN) are upstream of the Pole Canyon ODA and track the volume and quality of creek water entering the bypass pipeline and the infiltration basin. North Fork Sage Creek station NSV-5 is upstream of the confluence with Pole Canyon Creek. The other four stations, located downstream of the Pole Canyon ODA, include seepage from the downstream ODA toe at LP-1, lower Pole Canyon Creek station LP-PD, North Fork Sage Creek station NSV-6, and lower Sage Creek upstream of Hoopes Spring at station LSV-1. The 2018 surface water quality data are discussed separately for spring high-flow and fall low-flow conditions.

3.2.2 Surface Water Flow

Surface water flow measurements for spring and fall 2018 are provided in Table 3-3 and are discussed for Pole Canyon Creek, North Fork Sage Creek, and lower Sage Creek.

<u>Pole Canyon Creek</u>

Surface water flow measurements are automatically recorded through the use of pressure transducers equipped with data loggers at four locations within the Pole Canyon Creek drainage (from upstream to downstream): UP-PD, UP-IN, LP-1, and LP-PD (Figure 3-2). A discussion regarding pipeline flow, as measured at the inlet (UP-PD) and outlet (LP-PD), is provided in Section 2.2.

Flow rate and annual cumulative flow hydrographs for UP-IN (upstream of the infiltration basin) are shown in Figure 3-3. Approximately 210 acres of the upper Pole Canyon Creek watershed (Figure 1-2), as well as two small Dinwoody Formation springs located immediately upstream of the flume at UP-IN, contribute to flow at this monitoring location.

The cumulative flow hydrograph provided on Figure 3-3 shows the minimum and maximum annual cumulative flow recorded at UP-IN for the period of record from 2009 through 2017 as well as the cumulative flow for 2018. In 2018, approximately 166 acre-feet of water flowed through the UP-IN flume into the infiltration basin. The minimum (105 acre-feet) and maximum (432 acre-feet) annual cumulative flow volumes through the UP-IN flume occurred during 2013 and 2017, respectively. The peak flow rate recorded at the UP-IN flume in 2018 was 1.1 cfs, which is similar to previous peak flow rates, but much lower than the peak flow rate recorded in 2017 (3.4 cfs). The amount of winter precipitation that occurred during the 2017 water year was much greater than average. Additionally, the cumulative flow volume and peak flow rate recorded at UP-IN during 2011 was much greater than other years; however, these data are not comparable since the Pole Canyon pipeline was bypassed during the 2011 runoff season and all flow from upper Pole Canyon Creek reported to UP-IN.

Flow rate and annual cumulative flow hydrographs for LP-1 (immediately downstream of the Pole Canyon ODA toe) are shown on Figure 3-4. The flow recorded at LP-1 represents seepage through the Pole Canyon ODA that is derived from incident precipitation on the surface of the ODA. Water from the Panel A storm water collection ditch no longer flows across the Pole Canyon ODA since implementation of the 2013 NTCRA and therefore does not contribute to flow at LP-1. The post-2013 NTCRA configuration of the run-on controls directs the relatively clean storm water from Panel A around the ODA material. In addition, clean stormwater is also directed off the cover to several sedimentation basins (Figure 1-3).

The cumulative flow hydrographs provided on Figure 3-4 show the minimum and maximum annual cumulative flow recorded at LP-1 for the period of record from 2009 through 2017 as well as the cumulative flow for 2018. Cumulative flow for LP-1 during 2018 was estimated at 4.6 acre-feet. The maximum cumulative flow at LP-1 was recorded in 2014 (28 acre-feet); the minimum cumulative flow was recorded in 2013 (2 acre-feet), which was a drier than normal year.

Immediately downstream from the toe of the ODA, the flow observed at LP-1 infiltrates into underlying alluvial deposits and possibly the Wells Formation aquifer. During the spring 2018 sampling event, seep water from the ODA toe seep was observed to infiltrate within a short distance downstream of LP-1 before reaching the point where mixing with surface water flow could occur downstream of the bypass pipeline outlet at LP-PD. The pipeline discharge also flowed for only a short distance and then infiltrated into the ground. Flow from the pipeline did not reach northern Sage Valley or North Fork Sage Creek. These observations are consistent with observations made in previous years.

North Fork Sage Creek and Lower Sage Creek

Manual flow measurements are collected along North Fork Sage Creek (NSV-5 and NSV-6) and lower Sage Creek (LSV-1) during the spring and fall (Table 3-3). Station NSV-5, located along North Fork Sage Creek upstream of the confluence with Pole Canyon Creek, has dense vegetation and shallow flow. Flow measured at NSV-5 in May 2018 was 0.42 cfs. Flow was not measured at NSV-5 in October. Downstream at NSV-6, flow was measured at 3.8 cfs and 0.2 cfs in May and October, respectively. Station LSV-1 is located farther downstream below the confluence with Sage Creek. During 2018, LSV-1 flow was measured at 28.7 cfs in May and 3.1 cfs in October.

3.2.3 Surface Water Quality

Selenium concentrations in surface water samples collected in 2018 are reported in Table 3-4 and discussed separately by sampling event. Total selenium concentrations are shown on Figure 3-5. For comparison, the State of Idaho surface water quality criterion for aquatic life (surface water quality standard) (Idaho Administrative Procedures Act [IDAPA] 58.01.02) for selenium is 0.005 milligrams per liter (mg/L).

Spring High-Flow Conditions

Surface water samples were collected in May along Pole Canyon Creek downstream of the Pole Canyon ODA at LP-1 and LP-PD. Total selenium was detected at LP-PD at a concentration of 0.0009 mg/L. The concentration of total selenium at LP-1 was 4.91 mg/L. As shown on Figure 3-5, this concentration is lower than concentrations measured during spring monitoring events since the 2006 NTCRA was implemented (with the exception of spring 2013) but is higher than selenium concentrations at LP-1 before then. Total selenium concentrations at LP-1 continue to exceed the water quality standard.

In May 2018 during the high-flow period, surface water samples were collected from North Fork Sage Creek upstream and downstream of the confluence with Pole Canyon Creek (NSV-5 and NSV-6, respectively) and from Sage Creek downstream of the confluence with North Fork Sage Creek (LSV-1). The total selenium concentration at NSV-5 was 0.0002 mg/L and farther downstream at NSV-6 the concentration was higher at 0.005 mg/L. Downstream of the confluence of Sage Creek and North Fork Sage Creek at LSV-1, the total selenium concentration in May was 0.0012 mg/L. The concentration at NSV-6 is at the water quality standard while the concentrations at NSV-5 and LSV-1 were below the water quality standard.

Fall Low-Flow Conditions

Surface water samples were collected in October downstream of the Pole Canyon ODA at LP-1 and LP-PD. Total selenium was detected at a concentration of 0.0003 mg/L at LP-PD. The concentration of total selenium at LP-1 was 2.44 mg/L. As shown on Figure 3-5, this is the lowest concentration measured since the bypass pipeline became operational, but higher than selenium concentrations measured before then. All of the total selenium concentrations at LP-1 exceeded the water quality standard; however, concentrations appear to be generally decreasing since completion of the Dinwoody/Chert cover system for the 2013 NTCRA in late 2015.

In October 2018 during the low-flow period, surface water samples were collected from North Fork Sage Creek (NSV-5 and NSV-6) and Sage Creek (LSV-1). Total selenium was not detected at NSV-5. Selenium was detected in surface water from NSV-6 at 0.0004 mg/L. Farther downstream at LSV-1, the total selenium concentration was measured at 0.0005 mg/L. All of these concentrations were below the water quality standard.

Mass Loading Evaluation

Selenium loading was evaluated using selenium concentrations and corresponding flow measurements for monitoring conducted May 14 through 18, 2018 (Figure 3-6). In lower Pole Canyon at the ODA toe seep (LP-1), the selenium mass load was estimated at 0.56 pounds per day (lbs/day). This selenium load was less than the load estimated for each high flow sampling event since 2008, with the exception of 2010 (Formation 2012a).

Since completion of the 2006 NTCRA, seep discharges at LP-1 infiltrate to the underlying alluvial groundwater (and potentially the deeper Wells Formation aquifer) upgradient of the bypass pipeline discharge at LP-PD. Exceptions occurred during brief periods in spring 2008 and spring 2011 (Formation 2012b) when flow from the toe seep at LP-1 reached the channel as a result of higher than normal spring runoff. The reduction of flow from LP-1 to Sage Valley results in a decrease in total selenium mass load downstream at NSV-6 and LSV-1.

The selenium mass load for NSV-6 and LSV-1 in May were 0.1 and 0.19 lbs/day, respectively. The increase in the selenium mass load from NSV-6 to LSV-1 indicates a potentially gaining stream reach due to alluvial groundwater discharge to surface water. The potential discharge of shallow alluvial groundwater, particularly during spring high-flow conditions, was identified in the Final RI Report as a transport pathway for selenium to surface water at NSV-6 (Formation 2014c). Because loading from LP-1 has been reduced, concentrations measured in NSV-6 water are expected to decrease over time (Formation 2014c). As shown on Figure 3-5, with the exception of the May sample collected at NSV-6 (0.005 mg/L), selenium concentrations at all Sage Valley surface water monitoring locations were below the water quality standard during 2018.

The mass load at NSV-5, which is located upstream of the confluence with Pole Canyon Creek, was 0.0004 lbs/day. Flow can be difficult to accurately measure at NSV-5 due to the presence of significant vegetation on both banks, and also because the reach is often ponded or, at best, is very shallow and meandering at a very low velocity.

3.3 Groundwater

Effectiveness monitoring activities were performed, and data were collected at the locations specified in EMP Rev 5 (Formation 2018). These locations are used for the effectiveness evaluation because they are affected only by the Pole Canyon ODA source.

The following monitoring activities are described:

- Semiannual and continuous groundwater level measurements at GW-15, GW-16, GW-22, and GW-26
- Semiannual water-quality monitoring of alluvial groundwater at wells GW-26, GW-15, and GW-22
- Semiannual water-quality monitoring of Wells Formation groundwater at well GW-16.

Groundwater monitoring locations are shown on Figure 3-2; sample dates are listed in Table 3-5. A description of the field activities that were conducted and the monitoring results obtained is presented below. There were no deviations from monitoring specifications in EMP Rev 5. Electronic data files are included as Appendix C.

3.3.1 Field Activities

Monitoring well locations are equipped with pressure transducers and data loggers to obtain a continuous record of groundwater levels. Additionally, manual groundwater measurements are collected at the time of sampling and are used to calibrate the transducer measurements.

Semiannual groundwater quality samples were collected at each monitoring location in May and October 2018 (Table 3-5). Monitoring wells GW-26, GW-15, and GW-22 monitor alluvial groundwater. Well GW-26 is located between the downstream toe of the Pole Canyon ODA and the outfall of the bypass pipeline, which discharges to the Pole Canyon Creek flow channel. Groundwater quality at GW-26 reflects conditions in the alluvium immediately downgradient of the ODA. Well GW-15 is located downgradient of the bypass pipeline outfall and reflects conditions in alluvial groundwater influenced by the discharge from the bypass pipeline. Well GW-22 monitors groundwater from two depths (90-100 feet, 148-150 feet) farther downgradient of the ODA in northern Sage Valley. Well GW-16 monitors groundwater quality in the Wells Formation bedrock immediately downgradient of the Pole Canyon ODA.

3.3.2 Groundwater Elevations

<u>Groundwater Elevations in Alluvium</u>

Alluvial groundwater elevation data collected during 2018 for monitoring wells GW-26, GW-15, and GW-22 are presented in Figure 3-7. Long-term groundwater elevation data are presented in Figure 3-8.

Monitoring well GW-26 is located at the toe of the ODA, upgradient of GW-15. The water levels in GW-26 are generally about 30 feet higher than the water levels in GW-15 and indicate a relatively steep hydraulic gradient within the alluvial deposits as they fan out from Pole Canyon into Sage Valley. Generally, groundwater elevations at GW-26 are highest during spring high-flow conditions (Figure 3-7 and Figure 3-8). Since construction of the 2013 NTCRA Dinwoody/Chert cover system, groundwater elevations in GW-26 have exhibited relatively rapid changes due to precipitation events as was observed multiple times during 2018 (Figure 3-7). The cover system has reduced infiltration into the ODA, resulting in increased runoff and infiltration into the alluvial aquifer downgradient of the ODA in the vicinity of GW-26.

During 2018, groundwater levels showed a greater than normal decrease during the winter (January through March), as shown on Figure 3-8. A similar magnitude decline in groundwater levels were observed during 2011. As discussed previously, Pole Canyon Creek flow bypassed the pipeline during both of these years. As such, the alluvium downgradient of the ODA did not receive recharge from Pole Canyon Creek since the pipeline was not discharging. Once flow began entering and discharging from the pipeline, groundwater elevations at GW-15 increased rapidly beginning in April and continued to increase as flow from the bypass pipeline increased during the onset of spring runoff (Figure 3-7), with the highest water levels observed in middle to late May. Water levels generally deceased in GW-15 from mid-May through October. Since the 2006 NTCRA was implemented in late 2007, water levels in the alluvial deposits below the Pole Canyon ODA, measured at GW-15, have fluctuated (Figure 3-8); however, the water levels have generally been higher since the bypass pipeline was constructed. Changes in the water supply to alluvial groundwater, resulting from routing of Pole Canyon Creek stream flow around the ODA, likely resulted in higher water levels at GW-15. Water discharging from the pipeline can enter the alluvial deposits immediately upgradient of GW-15. In addition, during seasonally dry conditions (i.e., winter), the discharge from the pipeline outlet is usually larger than the discharge associated with lower Pole Canyon Creek before implementation of the 2006 NTCRA, resulting in a more constant supply of alluvial groundwater recharge at GW-15. Increased runoff from the ODA following construction of the 2013 NTCRA Dinwoody/Chert cover system has also increased recharge to the alluvial aquifer downgradient of the ODA.

Well GW-22 monitors groundwater within the alluvial deposits in northern Sage Valley, downgradient of the alluvial deposits in lower Pole Canyon. The water level at GW-22 is approximately 100 feet lower than the water level at GW-15. Additionally, the hydrograph for alluvial groundwater at GW-22 is distinctly different than the hydrograph for alluvial groundwater at GW-15 (Figure 3-7 and Figure 3-8). Well GW-22 exhibits distinct seasonal fluctuations, but the hydrograph generally reflects gradual changes in water levels, rather than the smaller more frequent changes in water levels measured at GW-15 due to pipeline discharges. The annual low and high-water levels at GW-22 in 2018 were similar to the low and high-water levels recorded in previous years, with the exception of the high-water levels recorded in 2011 and 2017, both of which were wetter-than-normal years.

<u>Groundwater Elevations in Wells Formation</u>

Figure 3-9 presents the groundwater elevation data collected from 2003 through 2018 for Wells Formation monitoring well GW-16. Groundwater at GW-16 exhibits a seasonal pattern of rapidly increasing water levels in late-spring and early-summer (starting in April and peaking in July or August) and gradually declining water levels the rest of the year. Historically, groundwater elevations at any individual location typically fluctuated about 6 to 9 feet; in 2011 and 2017, which were wetter-than-normal years, groundwater elevations fluctuated about 15 to 17 feet. In 2018, Wells Formation groundwater elevations fluctuated about 5 feet, which is similar to historical fluctuations, but groundwater elevations remained higher than normal due to the high-water year in 2017.

3.3.3 Groundwater Quality

Selenium concentrations in groundwater samples collected in 2018 are reported in Table 3-6 and discussed separately for alluvial groundwater and for groundwater in the Wells Formation aquifer. For comparison, the primary constituent standard for selenium in groundwater under the State of Idaho Ground Water Quality Rule (IDAPA 58.01.11) is 0.05 mg/L.

<u>Groundwater Quality in Alluvium</u>

Alluvial groundwater quality is currently monitored at three locations downgradient of the Pole Canyon ODA (Figure 3-2) to track groundwater quality along the alluvial groundwater flow path from the Pole Canyon ODA to Sage Valley. From upgradient to downgradient, these monitoring wells are GW-26, GW-15 and GW-22. Well GW-26, which is located at the toe of the ODA near surface water monitoring station LP-1, was first sampled in March 2009. Well GW-15, located farther downgradient in lower Pole Canyon below the pipeline outlet has been sampled since fall 2003. Well GW-22, which is installed in the thick alluvial deposits within northern Sage Valley downgradient of Pole Canyon, has been sampled since fall 2004. Figure 3-10 presents the total selenium concentrations reported for the alluvial groundwater samples collected from these wells through 2018.

Alluvial groundwater monitoring well GW-26 exhibits the most rapid response to selenium loads discharging from LP-1 because the well screen is shallow, and the well is closest to the Pole Canyon ODA toe seep. The total selenium concentration in alluvial groundwater collected from GW-26 in spring and fall were above the groundwater quality standard at 1.74 and 2.2 mg/L, respectively (Figure 3-10). Since implementation of the 2013 NTCRA, selenium concentrations at GW-26 in the spring have significantly decreased. The decreasing concentration trend at GW-26 began in 2016, the first year after construction of the cover system. The reduced selenium concentration appears to be the result of less infiltration through the ODA overburden and increased runoff from the cover that infiltrates into the alluvial aquifer in the vicinity of GW-26.

Farther downgradient, and downstream of the bypass pipeline discharge at LP-PD, the total selenium concentration in GW-15 groundwater (Figure 3-10) was above the groundwater quality standard during spring runoff (0.118 mg/L) and decreased in the fall (0.0247 mg/L) to below the standard. The lower selenium concentrations in alluvial groundwater at GW-15 as compared to GW-26 can be attributed to the effects of recharge to alluvial groundwater from clean creek water that is discharged from the bypass pipeline in lower Pole Canyon just upgradient of GW-15. Concentrations of selenium in groundwater in GW-15 are diluted as a result of this discharge and increased runoff from the cover.

Monitoring well GW-22 is completed in valley-fill alluvial deposits in Sage Valley downgradient of Pole Canyon Creek. Samples were collected at GW-22 from two distinct depths: 90 to 100 feet and 148 to 150 feet. As shown in Figure 3-10, selenium concentrations vary with depth and over time. Groundwater collected from the shallower depth generally has higher selenium concentrations than the deeper alluvial groundwater. In 2018 the highest selenium concentration (0.101 mg/L) was detected in the shallow interval in May, and the concentration was lower in October (0.0957 mg/L). The concentrations in the deeper sample interval showed a similar seasonal pattern with the higher concentration detected in May (0.0453 mg/L) and the lower concentration detected in October (0.0372 mg/L). Only the selenium concentrations in groundwater from the shallower interval exceeded the groundwater quality standard. Selenium concentrations have decreased since the 2013 NTCRA was completed.

<u>Groundwater Quality in Wells Formation</u>

Groundwater quality in the Wells Formation aquifer is currently monitored at one location (GW-16) (Figure 3-2). Total selenium concentrations reported for this well are presented in Figure 3-10.

Monitoring well GW-16 provides groundwater quality data for the Wells Formation aquifer immediately downgradient from the Pole Canyon ODA. Selenium concentrations reported for samples collected in May (0.646 mg/L) and October (0.543 mg/L) 2018 were the lowest concentrations measured since implementation of the 2006 NTCRA but remained above the groundwater quality standard. As shown in Figure 3-10, selenium concentrations at GW-16 have been relatively constant (approximately 0.8 to 0.9 mg/L) since the 2006 NTCRA was implemented and exhibit seasonal fluctuations. Since completion of the 2013 NTCRA, concentrations at GW-16 have decreased significantly.

3.4 Vegetation Monitoring

Effectiveness monitoring activities were performed, and data were collected at vegetation monitoring locations specified in EMP Rev 5 (Formation 2018). Vegetation community monitoring and tissue sample collection was conducted to assess vegetation cover conditions and determine selenium concentrations in vegetation growing on the Pole Canyon ODA 2013 NTCRA Dinwoody/Chert cover system. Construction of the cover system was completed in 2015.

Monitoring was conducted approximately 3 years after the cover was seeded, to allow time for the vegetation to become established.

The following monitoring activities were performed:

- Vegetation sampling in Zones 1 through 6 at locations PCO-15 through PCO-20

- Quantitative vegetation community and cover monitoring along two 50-meter (165-foot) transects within each zone.

Vegetation monitoring zones and transect locations are shown on Figure 3-11. A description of the field activities and the monitoring results obtained is presented below. There was one deviation from the monitoring specifications in EMP Rev 5. Zone 2 was augmented in April 2018 with topsoil and seed to improve the vegetation cover. Because the newer vegetation growth was sparser than in other zones, the forage composite sample in Zone 2 was collected from 8 subsamples from throughout the entire zone, rather than from within the 50-meter x 50-meter sampling plot. Electronic data files for the 2018 tissue samples are included in Appendix C. Additional details regarding the vegetation monitoring are presented in Appendix F.

3.4.1 Field Activities

The Pole Canyon ODA was divided into six vegetation monitoring zones based on the slope and aspect of the cover system, as shown on Figure 3-11. The six zones were as follows:

- Zone 1 East side east-facing slope at top of Pole Canyon NTCRA
- Zone 2 East side flat area at top of Pole Canyon NTCRA
- Zone 3 East-facing slope above east sedimentation basin
- Zone 4 East side south-facing slope above south-central sedimentation basin
- Zone 5 West side slope above west-side south sedimentation basin
- Zone 6 West side slope above west infiltration basin.

General forage vegetation samples were collected as a composite sample in each zone (for a total of six samples) and submitted for selenium analysis. Vegetation sampling results are presented in Section 3.4.2. Quantitative vegetation community monitoring was performed along two transects in each zone (for a total of 12 transects) using the Point-Intercept Method, which involves making observations at regular increments along the transect using a pin to record “hits” of plants, bare ground, or other ground cover. General conditions were noted, and photo documentation was collected within each zone. Vegetation cover estimates and a description of the vegetation community is presented in Section 3.4.3.

3.4.2 Selenium Concentrations in Vegetation

The selenium concentrations in the six composite vegetation samples (containing a mixture of forbs and grasses) ranged from non-detect to 0.246 milligrams per kilogram (mg/kg), with an average of 0.085 mg/kg. There is no standard for selenium in vegetation identified in the 2013 NTCRA PRSC Plan (Formation 2016) or EMP Rev 5 (Formation 2018). Vegetation sampling results are presented on Table 3-7.

3.4.3 Vegetation Community Transects

Overall, the Pole Canyon ODA vegetation cover is representative of a mixed-grassland in an early-successional status. Vegetation cover estimates are provided in Table 3-8. Zone 2 was augmented in April 2018 with topsoil and seed and so the monitoring results in that zone (17 percent [%] vegetation cover and no litter cover) reflect just three months of new growth rather than three years. Vegetation coverage in the other zones ranged from 23 to 51%; litter was 5 to 16% of the ground cover; and bare ground was 6 to 30%. In all zones, the vegetation growth ranged from areas with sparse vegetation and bare ground patches to more dense areas with robust, tall grass growth and litter accumulation. The vegetation cover in Zone 6 reflects the drier, rockier substrate on that slope than was observed on the transects of the other zones.

Detailed vegetation community data, including vegetation cover descriptions, photo documentation, species diversity, percent cover by seeded and non-seeded species, and presence of undesirable species information is provided in Appendix F. Overall, grass species from the reclamation seed mix were the dominant vegetation at the Pole Canyon ODA, with presence of a variety of seeded and non-seeded forbs as well. Species diversity (number of species) ranged from 10 to 13 seeded species and 4 to 14 non-seeded species within each zone. The selenium-accumulating species yellow sweet clover was observed in all zones and alfalfa (Medicago sativa) was observed in three of the zones. A few plants of noxious weed thistles (*Carduus nutans* and *Cirsium arvense*) were observed.

As noted in Section 2, the cover is inspected semiannually to assess the general condition, erosion, vegetative growth, wattle conditions, and presence of undesirable species, and maintenance is performed as needed. These inspection activities will continue as per the 2013 NTCRA PRSC Plan (Formation 2016) and EMP Rev 5 (Formation 2018).

4.0 EFFECTIVENESS EVALUATION

This section uses a combination of monitoring data and computer modeling to quantitatively evaluate the overall effectiveness of both of the NTCRAs in reducing selenium transport from the Pole Canyon ODA to groundwater and surface water. Also, selenium concentrations in groundwater are compared to the groundwater quality standard (0.05 mg/L) and selenium concentrations in surface water are compared to the surface water quality standard (0.005 mg/L). The approach for the 2018 evaluation is the same as that used in previous years.

The decision rules in EMP Rev 5 (Formation 2018) focus on evaluating effectiveness by identifying changes in selenium concentrations associated with both NTCRAs, along with consideration of selenium mass load changes. The 2018 water-balance and mass-balance models have been developed to quantify the reduction in selenium mass transport from pre-NTCRA to post-NTCRA conditions. The 2018 model has been developed from all available data, and includes detailed flow measurements, selenium concentration monitoring results, and local meteorological data. Model runs for 2018 were developed to represent the following scenarios:

- With NTCRAs – Actual conditions including both the 2006 and 2013 NTCRAs

- Without NTCRAs – Hypothetical conditions that would have existed if no actions had been implemented

Comparison of the modeled annual selenium mass transport from the ODA was estimated for each of these scenarios and this serves as the basis for evaluating the overall effectiveness of the NTCRAs. Figure 4-1 illustrates the conceptual water-balance model developed for both the “with NTCRAs” and “without NTCRAs” scenarios and identifies each source of water inflow to the Pole Canyon ODA and each pathway for water outflow from the Pole Canyon ODA under these scenarios. Details of the water balance inflows and outflows is provided in Appendix E.

The effectiveness of the 2013 NTCRA in reducing or eliminating risks due to ingestion of vegetation was evaluated based on observed selenium concentrations in vegetation growing on the Pole Canyon ODA cover. If post-NTCRA selenium concentrations in vegetation are the same or have increased relative to pre-NTCRA concentrations, then effectiveness of the 2013 NTCRA has not been demonstrated. If selenium concentrations in vegetation have decreased relative to pre-NTCRA concentrations, then the effectiveness of the 2013 NTCRA has been demonstrated.

4.1 Results of Statistical Analysis of Selenium Concentrations in Groundwater and Surface Water

A statistical evaluation of the pre- and post-NTCRA monitoring data was performed to evaluate the effectiveness of the NTCRAs in reducing selenium transport from the Pole Canyon ODA to surface water and groundwater pathways in accordance with EMP Rev 5 (Formation 2018). Pre-NTCRA data cover the period prior to implementation of the 2006 NTCRA (May 2000 through September 2007), and post-NTCRA data cover the period following implementation of the 2006 NTCRA (September 2007 through September 2018). These data sets, which have been split into two groups to represent seasonal effects, are used in the statistical analysis for this report.

The data, statistical methods, and results are presented in Appendix D. Results of the statistical analysis of selenium concentrations at certain effectiveness monitoring locations include the folllowing:

- Statistically significant decreases in selenium concentrations since implementation of the 2006 NTCRA in alluvial groundwater at GW-15 for both seasons.

- Statistically significant increases in selenium concentrations since the 2006 NTCRA was implemented in Wells Formation groundwater downgradient of the Pole Canyon ODA (GW-16) for both seasons. However, total selenium concentrations were increasing prior to implementation of the 2006 NTCRA and remained relatively steady after construction was completed. Since implementation of the 2013 NTCRA, total selenium concentrations in groundwater are decreasing at GW-16 (as shown on Figure 3-10) and the 2018 concentrations were the lowest measured since 2008.

- Statistically significant decreases in selenium concentrations since implementation of the 2006 NTCRA in surface water in Sage Creek (LSV-1) for both seasons. Selenium concentrations were below the surface water quality standard during 2018.

- Statistically significant increases in selenium concentrations since the 2006 NTCRA was implemented in surface water in North Fork Sage Creek (NSV-6) for spring-summer. However, selenium concentrations have decreased over time and total selenium concentrations in surface water at NSV-6 remained at or below the surface water quality standard during 2018.

4.2 Annual Water-Balance and Mass-Balance Comparison Results

The results from the water-balance and mass-balance models, described in Appendix E, were used to compare the selenium load released over an entire “with NTCRAs” scenario year (from December 1 through November 30) to the hypothetical “without NTCRAs” scenario year to determine the effectiveness of the NTCRAs.

4.2.1 Water-Balance Inflows

Results of the water-balance inflow calculations are presented and discussed in this section. Table 4-1 provides the water-balance inflow results for both scenarios, including the variation in annual water-balance inflows since 2008. Assumptions and approaches for the calculations are discussed in Appendix E.

Table 4-1: 2018 Pole Canyon ODA Water-Balance Model Inflow Summary

	Without NTCRAs	**With NTCRAs**	**Estimated Reduction**
Inflow	(acre-feet)	(acre-feet)	(percent)
Upper Pole Canyon Creek flow	480	0	100%
Direct infiltration into ODA from surface	51	25	51%
Run-on from upslope area due north of ODA	53	0	100%
Run-on from Panel A storm water collection ditch	46	0	100%
Total	**630**	**25**	**96%**

4.2.1.1 Upper Pole Canyon Creek Flow

The 2006 NTCRA eliminated the upper Pole Canyon Creek pathway to the Pole Canyon ODA. Therefore, the “with NTCRAs” scenario assumes the total Upper Pole Canyon Creek inflow is 0 acre-feet. For the “without NTCRAs” scenario, the estimated 2018 annual volume for this pathway was 480 acre-feet, which includes:

- 160 acre-feet of creek flow diverted through the bypass pipeline around the ODA and measured at the pipeline inlet (station UP-PD).
- 166 acre-feet of runoff generated above the infiltration basin measured at station UP-IN.
- 154 acre-feet of runoff reporting to the infiltration basin from the drainage between UP-IN and the infiltration basin (estimated using HELP3 model [Appendix E] for undisturbed ground over the year from December 1, 2017 through November 30, 2018).

4.2.1.2 Direct Infiltration

The 2006 NTCRA had no effect on the amount of water that entered the ODA via direct infiltration, but the 2013 NTCRA included the placement of the Dinwoody/Chert cover system in 2015. The 2018 water-balance model is the third year to take the 2013 NTCRA cover system into consideration (Table 4-1). For the “with NTCRAs” scenario in 2018, direct infiltration into the Pole Canyon ODA was calculated at 2.5 inches, which equals 25 acre-feet over the 120-acre area. For the “without NTCRAs” scenario, direct infiltration was calculated at 5.1 inches which equals a total volume of 51 acre-feet.

4.2.1.3 Run-On from Upslope Area Due North of the ODA

The 2006 NTCRA (i.e., “with NTCRAs”) resulted in elimination of the potential run-on from the 95-acre area upslope/north of the ODA, with an annual 2018 volume of 0 acre-foot. The “without NTCRAs” scenario estimates a hypothetical annual 2018 volume of 53 acre-feet entering the Pole Canyon ODA via the upslope run-on pathway.

4.2.1.4 Run-On from Panel A Storm Water Collection Ditch Crossing ODA

Based on construction of the 2013 NTCRA Dinwoody/Chert cover system in 2015, the “with NTCRAs” volume of Panel A storm water runoff annual 2018 volume was set at 0 acre-foot. The “without NTCRAs” scenario estimates a hypothetical annual 2018 volume of 46 acre-feet entering the Pole Canyon ODA via this pathway.

4.2.2 Water-Balance Outflows

Results of the water-balance outflow calculations are presented and discussed in this section. Table 4-2 presents a summary of the 2018 outflow results. The total annual outflow of water from the Pole Canyon ODA is equal to the total annual inflow. Water exits the ODA along three primary pathways:

- Surface water flow pathway, via lower Pole Canyon Creek
- Alluvial groundwater flow pathway
- Wells Formation groundwater flow pathway

The NTCRAs do not eliminate any of these pathways; however, because the NTCRAs reduce the total annual inflow to the ODA, there is a corresponding reduction in the amount of water that flows out from the ODA along all three of these pathways.

Continuous flow occurred at the toe seep LP-1 in 2018. Changes to the transducer vent line configuration in 2018 resulted in more reliable flow data for LP-1 throughout the year. The total annual cumulative volume leaving the ODA in 2018 via the surface water pathway was estimated to be 4.6 acre-feet.

Table 4-2: 2018 Pole Canyon ODA Water-Balance Model Outflow Summary

	Without NTCRAs	**With NTCRAs**	**Estimated Reduction**
Outflow	(acre-feet)	(acre-feet)	(percent)
Surface water discharge to lower Pole Canyon (measured at LP-1)	332	4.6	99%
To alluvial groundwater	65	11.2	83%
To Wells Formation groundwater	233	9.3	96%
Total	**630**	**25**	**96%**

The outflow volume for the surface water pathway was calculated using the transducer data discussed above, and the alluvial and Wells Formation outflows were estimated based on the water-balance assumptions as described in Appendix E.

4.2.3 Mass Balance Scenarios and NTCRA Effectiveness

The calculated annual selenium mass loads transported from the Pole Canyon ODA for the “with NTCRAs” and “without NTCRAs” scenarios during 2018 are provided in Table 4-3. The annual selenium load was calculated by multiplying the annual volume of water leaving the ODA (via each pathway) by the annual average selenium concentration in that type of water (i.e., surface water or groundwater). In the 2018 “without NTCRAs” scenario, the selenium load was approximately 1,347 pounds. In the “with NTCRAs” scenario, the selenium load was reduced to approximately 86 pounds resulting in an overall reduction in selenium mass transport of 94 percent. Table 4-4 provides a summary comparison of total selenium mass transport by year for the “with NTCRAs” and “without NTCRAs” scenarios.

Mass loads were also calculated for each outflow pathway using the annual outflow estimates presented in Table 4-3. For the 2018 “with NTCRAs” and “without NTCRAs” scenarios, selenium mass transport via discharge to lower Pole Canyon Creek was reduced by approximately 94 percent, selenium transport to alluvial groundwater was reduced by approximately 83 percent, and selenium transport to the Wells Formation was reduced by approximately 96 percent.

Table 4-3: 2018 Pole Canyon ODA Mass-Balance Model Summary

	Without NTCRAs	With NTCRAs	Estimated Reduction
Annual Selenium Mass Transport			(percent)
Annual average selenium concentration in outflow surface water	1.1 mg/L	4.91 mg/L	---
Annual average selenium concentration in seepage to groundwater	0.44 mg/L	0.44 mg/L	---
To surface water in lower Pole Canyon Creek	993 lbs	62 lbs	94%
To alluvial groundwater	77 lbs	13 lbs	83%
To Wells Formation groundwater	277 lbs	11 lbs	96%
Total	**1,347 lbs**	**86 lbs**	**94%**

Note: Because there was only one sample collected during spring 2018, a flow-weighted concentration could not be calculated, and the annual concentration was set at 4.91 mg/L.

Table 4-4: Annual Selenium Mass Transport, by Year, from the Pole Canyon ODA

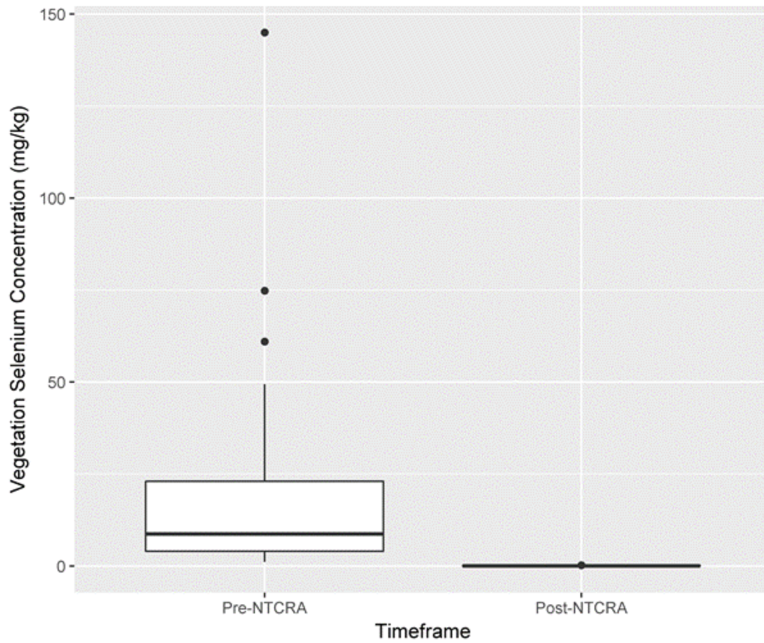
Year	Without NTCRAs (lbs)	With NTCRAs (lbs)	Annual Load Reduction Due to NTCRAs (lbs)	Percent Reduction in Annual Selenium Mass Transport
2008	1,570	170	1,400	**89%**
2009	2,200	230	1,970	**90%**
2010	1,470	80	1,390	**95%**
2011	5,980	1,250	4,730	**79%**
2012	1,630	210	1,420	**87%**
2013	1,220	140	1,080	**89%**
2014	2,060	470	1,590	**77%**
2015	1,450	190	1,260	**87%**
2016	1,840	190	1,650	**90%**
2017	4,140	233	3,907	**94%**
2018	1,347	86	1,261	**94%**

Note: 2018 loads were calculated using annual average selenium concentrations and total annual outflows (Table 4-2).

4.3 Evaluation of Selenium Concentrations in Vegetation

Implementation of the 2013 NTCRA was expected to result in reductions in selenium concentrations in vegetation growing on the Dinwoody/Chert cover system, relative to pre-NTCRA conditions. Selenium concentrations in pre-NTCRA forage vegetation growing on the cover system ranged from 1.1 to 145 mg/kg, with an average of 18 mg/kg (based on 47 samples from 17 vegetation locations: PT-7 through PT-13 and PCO-5 through PCO-14). The 2018 vegetation monitoring data confirm that average selenium concentrations in post-NTCRA vegetation (0.085 mg/kg) (Table 3-7) have decreased relative to the pre-NTCRA average concentration (18 mg/kg), as shown by the boxplots in Figure 4-2.

Figure 4-2: Pre- and Post-NTCRA Vegetation Selenium Concentrations



In addition to the boxplot comparison, a non-parametric test was used to determine that post-NTCRA results are statistically lower than pre-NTCRA conditions. Therefore, the Dinwoody/Chert Cover NTCRA is effective in reducing or eliminating potential risks from ingestion of vegetation growing on the Pole Canyon ODA cover. The decision rule for evaluating the effectiveness of the Pole Canyon 2013 Dinwoody/Chert Cover NTCRA has been met and no cover modifications or additional vegetation monitoring are needed.

5.0 SUMMARY

This section provides a summary of the 2018 effectiveness monitoring results as required by EMP Rev 5 (Formation 2018), and the 2018 performance evaluation as required by the 2006 NTCRA PRSC Plan (NewFields 2009) and 2013 NTCRA PRSC Plan (Formation 2016). The 2018 effectiveness evaluation includes a statistical evaluation of changes in selenium concentrations in surface water and groundwater, comparisons of water-balance and mass-balance calculations for the "with NTCRAs" and "without NTCRAs" scenarios, comparisons of pre- and post-NTCRA selenium concentrations in vegetation growing on the Pole Canyon ODA cover system, and an evaluation of the vegetation community.

5.1 Performance Evaluation

The 2006 NTCRA components (bypass pipeline, sedimentation basin, infiltration basin, and run-on control channel) and 2013 NTCRA components (Dinwoody/Chert cover system, access roads, drainage control features, sedimentation basins, and reclaimed borrow area) were inspected and the various components were observed to be in good condition. Maintenance and repair activities performed in 2018 included patching a minor piping failure below the pipeline influent structure and addressing areas of erosion, repairing erosion control structures, and removing sediment from sedimentation basins.

A flow evaluation was conducted of the bypass pipeline using continuous flow data collected at the pipeline inlet (UP-PD) and pipeline outlet (LP-PD). A comparison of cumulative flow volume (for the period of overlapping data) showed a small difference of about 3 percent at the end of 2018. The outflow estimate is higher than the inflow estimate, which indicates no leakage from the pipeline.

5.2 Effectiveness Evaluation

Data were collected in 2018 at monitoring locations for surface water (UP-PD, UP-IN, LP-1, LP-PD, NSV-5, NSV-6, LSV-1); alluvial groundwater (GW-26, GW-15, GW-22); and Wells Formation groundwater (GW-16). Results for these locations are summarized as follows:

- Selenium was not detected or detected at very low concentrations at UP-PD, UP-IN, and LP-PD.

- Selenium concentrations at LP-1 were 4.91 mg/L in spring and 2.44 mg/L in the fall. The fall concentration is the lowest concentration measured since the bypass pipeline became operational. Water discharging from LP-1 infiltrates into the alluvium and all surface water flow is lost upgradient of the bypass pipeline outlet (LP-PD).

- Total selenium concentrations in surface water at NSV-5, NSV-6, and LSV-1 were at or below the surface water quality standard.

- Concentrations of total selenium in alluvial groundwater from wells GW-15 and GW-26 were above the groundwater quality standard but have generally decreased since completion of the 2013 NTCRA.

- Total selenium concentrations in the shallow (90-100 feet) interval of alluvial monitoring well GW-22 exceeded the groundwater quality standard while concentrations in the deep (148-150 feet) interval were below the standard. Concentrations for both depth intervals have generally decreased since completion of the 2013 NTCRA.

- Concentrations of total selenium in Wells Formation groundwater from well GW-16 were above the groundwater quality standard. Selenium concentrations have decreased since completion of the 2013 NTCRA and 2018 concentrations were the lowest since 2008.

5.2.1 Statistical Analysis of Selenium Concentrations

Statistically significant decreases in selenium concentrations were confirmed at the 90 percent confidence level downgradient and downstream of the Pole Canyon ODA in alluvial groundwater (GW-15) and in surface water in North Fork Sage Creek (NSV-6 during fall-winter) and in lower Sage Valley (LSV-1). Time-series plots show that post-2013 NTCRA selenium concentrations have decreased at all of the surface water and groundwater effectiveness monitoring locations used for the statistical analysis during both seasons.

5.2.2 Water-Balance and Mass-Balance Comparisons

The findings of the water-balance and mass-balance comparisons, using data collected for the effectiveness monitoring locations, are summarized as follows:

- Water-balance models estimate a 96 percent reduction in the annual inflow of water to the Pole Canyon ODA in 2018 as a result of the NTCRAs. Estimated reductions in the annual water inflow to the ODA resulted in equivalent reductions in the annual outflow from the ODA (96 percent).

- Monitoring data indicate an estimated annual reduction in selenium mass transport from the ODA of 1,261 pounds (94 percent) in 2018 as a result of the NTCRAs. The estimated load of selenium released from the ODA to the environment was 86 pounds in 2018.

- The Dinwoody/Chert cover system constructed under the 2013 NTCRA reduced inflows entering the ODA.

- The mass-balance model shows that implementation of the NTCRAs has resulted in a reduction in the annual selenium mass transport from the Pole Canyon ODA.

5.2.3 Selenium Concentrations in Vegetation

The findings of the vegetation monitoring using data collected at locations on the Dinwoody/Chert cover system, are summarized as follows:

- The average selenium concentration in post-NTCRA vegetation (0.085 mg/kg) has decreased relative to the pre-NTCRA average concentration (18 mg/kg), and therefore, the 2013 NTCRA Dinwoody/Chert cover is effective in reducing or eliminating potential risks from ingestion of vegetation growing on the Pole Canyon ODA.

- Overall, the Pole Canyon ODA vegetation cover is representative of a mixed-grassland community in an early-successional status.

Because post-NTCRA selenium concentrations in vegetation have decreased relative to pre-NTCRA concentrations, the 2013 NTCRA is effective at reducing or eliminating the potential risks via ingestion of vegetation and no cover modifications or additional vegetation community monitoring or sample collection are needed.

6.0 REFERENCES

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TABLES

Table 3-1
Monthly Precipitation Totals for the Smoky Canyon Mine (2004–2018)

Month	Monthly Precipitation (inches)															
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**15-Year Average (2004-2018)**
December[1]	**2.81**	1.64	**4.31**	1.94	**2.18**	2.02	1.52	2.73	0.97	2.74	1.83	1.77	1.39	3.31	1.63	2.19
January	2.27	2.08	**4.18**	0.85	**2.72**	**2.85**	1.99	**2.61**	2.24	1.63	2.11	1.01	**3.33**	**4.89**	2.09	2.46
February	1.35	1.40	1.41	1.50	1.86	1.99	0.97	1.73	**2.25**	0.99	**4.72**	0.96	1.54	**5.5**	**2.08**	2.02
March	1.17	**2.16**	**2.07**	1.19	**2.38**	**2.56**	0.86	**3.32**	1.10	1.84	**2.34**	0.79	**2.56**	**2.46**	**2.80**	1.97
April	1.52	1.38	**2.37**	1.89	1.31	**2.54**	**3.36**	**4.24**	2.22	**2.47**	1.57	1.74	2.00	**3.09**	**2.58**	2.29
May	**4.19**	**4.13**	1.02	0.47	**2.60**	2.56	1.91	**3.14**	1.77	**2.61**	0.93	**5.40**	**3.64**	1.89	2.21	2.56
June	**4.39**	**3.24**	0.91	0.77	**2.33**	**6.31**	**2.89**	**2.09**	0.11	0.09	1.60	1.38	1.01	1.12	1.39	1.98
July	0.78	0.52	**0.90**	**1.51**	0.02	0.57	0.26	**1.92**	**0.96**	**2.00**	0.63	**1.63**	0.27	0.15	0.24	0.82
August	**2.63**	1.52	1.22	1.09	0.67	1.11	**1.78**	**2.20**	0.04	1.12	**5.06**	1.45	0.64	1.36	1.27	1.54
September	**2.89**	1.31	**2.14**	1.50	1.69	0.29	0.50	0.36	0.42	**2.92**	**4.34**	**2.68**	**4.82**	**3.13**	0.18	1.94
October	**3.74**	1.39	1.67	**3.00**	0.66	**2.25**	**2.79**	**2.66**	1.67	1.84	0.91	0.53	**5.79**	0.75	**2.43**	2.14
November	0.72	**2.58**	**3.02**	1.03	**2.66**	0.21	**2.79**	1.85	1.92	1.34	**2.86**	**2.25**	1.12	**2.97**	1.67	1.93
Total	**28.46**	23.35	**25.22**	16.74	21.08	**25.26**	21.62	**28.85**	15.67	21.59	**28.90**	21.59	**28.11**	**30.62**	20.57	*24.08*

Notes:

1. Annual precipitation calculated from December through November to account for snowfall accumulated in December of previous calendar year.
2. Precipitation amounts shown in bold are greater than the 15-year average precipitation total.

Table 3-2
Surface Water Monitoring Locations and Sample Dates

Monitoring Locations		2018 Surface Water Quality Sampling and Flow Measurements			
Location ID	**Location Description**	**Winter (Jan-Feb-Mar)**	**Spring (Apr-May-Jun)**	**Summer (Jul-Aug-Sep)**	**Fall (Oct-Nov-Dec)**
Pole Canyon Creek					
UP-PD	Upper Pole Canyon Creek (Post Diversion) 100 feet upstream of diversion structure	--	2018-05-14	--	2018-10-22
UP-IN	Upper Pole Canyon Creek upstream of infiltration basin	--	2018-05-14	--	2018-10-22
LP-1	Pole Canyon ODA toe seep	--	2018-05-18	--	2018-10-22
LP-PD	Lower Pole Canyon Creek (Post Diversion) at bypass pipeline dissipation structure	--	2018-05-18	--	2018-10-22
Northern Sage Valley					
NSV-5	North Fork Sage Creek upstream of Pole Canyon Creek	--	2018-05-18	--	2018-10-22
NSV-6	North Fork Sage Creek downstream of Pole Canyon Creek	--	2018-05-18	--	2018-10-22
Lower Sage Valley					
LSV-1	Lower Sage Creek downstream of the confluence with North Fork Sage Creek and upstream of Hoopes Spring	--	2018-05-16	2018-08-08	2018-10-24

Notes:

-- Sample collection not required.

Table 3-3
Manual Stream Flow Measurements

Location ID	Stream Flow (cubic feet per second)			
	Winter (Jan-Feb-Mar)	Spring[1] (Apr-May-Jun)	Summer[2] (Jul-Aug-Sep)	Fall[3] (Oct-Nov-Dec)
Pole Canyon Creek				
UP-PD[4]	--	3.67	--	0.173
UP-IN[5]	--	1.09	--	0.0413
LP-1[6]	--	0.0211	--	0.0033
LP-PD[4]	--	3.62	--	0.113
Northern Sage Valley				
NSV-5	--	0.416	--	Not Measured
NSV-6	--	3.78	--	0.201
Lower Sage Valley				
LSV-1	--	28.7	6.04	3.09

Notes:

1. Spring flow measurements were collected May 14-18, 2018.
2. Summer flow measurements were collected August 8, 2018
3. Fall flow measurements were collected October 22-25, 2018.
4. Continuous flow monitoring (see Figure 2-1)
5. Continuous flow monitoring (see Figure 3-3)
6. Continuous flow monitoring (see Figure 3-4)

-- Flow measurement not required.

Table 3-4
Surface Water Monitoring Results

		Field Parameters					Laboratory Parameters					
Location ID	**Date**	**Temperature (°C)**	**pH (S.U.)**	**Specific Conductivity (µmhos/cm)**	**Dissolved Oxygen (mg/L)**	**Turbidity (NTU)**	**Alkalinity, Total as $CaCO_3$ (mg/L)**	**Hardness, as $CaCO_3$ (mg/L)**	**Selenium, Dissolved (mg/L)**	**Selenium, Total (mg/L)**	**Sulfate (mg/L)**	**TDS (mg/L)**
State of Idaho Water Quality Criterion		NA	NA	NA	NA	NA	NA	NA	NA	***<u>0.005</u>***	NA	NA
Pole Canyon Creek												
UP-PD	2018-05-14	4.7	8.12	349.7	9.16	2.4	174	189	0.0002 U	0.0002 J	10.9	197
	2018-10-22	5	8.39	358.1	10.41	0.56	181	194	0.0002 U	0.0002 U	13.6	192
UP-IN	2018-05-14	4.4	7.94	390.5	9.24	0.4	195	213	0.0002 U	0.0002 J	15.7	219
	2018-10-22	5.4	7.98	417.4	9.23	0.6	215	227	0.0002 J	0.0002 U	22.3	245
LP-1	2018-05-18	11.5	7.26	293.9	10.11	8.38	337	2170	5.31	***<u>4.91</u>***	1800	2790
	2018-10-22	11.6	7.66	2984	6.41	41.2	354	2110	2.41	***<u>2.44</u>***	1870	2880
LP-PD	2018-05-18	4.6	8.45	349.1	32.12	1.56	177	195	0.0002 J	0.0009 J	11.1	196
	2018-10-22	7	8.43	350	10.4	0.02	179	193	0.0003 J	0.0003 J	14.5	198
Northern Sage Valley												
NSV-5	2018-05-18	7.3	7.81	328.9	20.83	6.45	163	171	0.0002 J	0.0002 J	9.84	206
	2018-10-22	8	8.1	290	10.05	14.2	203	214	0.0002 U	0.0002 U	19.9	252
NSV-6	2018-05-18	4.3	8.11	405.1	19.5	5.28	205	228	0.0051	***<u>0.005</u>***	29.4	253
	2018-10-22	1.4	8.1	537	11.88	8.98	269	294	0.0003 J	0.0004 J	30	310
Lower Sage Valley												
LSV-1	2018-05-16	10.6	8.37	363.8	10.97	9.23	187	202	0.0012 J	0.0012 J	14.1	225
	2018-08-08	17.4	8.62	360.7	8.36	9.02	182	204	0.0007 J	0.0007 J	22.2	214
	2018-10-24	9.7	8.29	395.1	10.66	1.78	189	209	0.0005 J	0.0005 J	28.7	236

Notes:

°C - degrees Celsius
S.U. Standard units.
mg/L - milligrams per liter
NTU - Nephelometric Turbidity Unit
TDS - Total Dissolved Solids
µmhos/cm - micro mhos per centimeter
1.State of Idaho Surface Water Quality for Aquatic Life (IDAPA 58.01.02; chronic criteria) chosen based on sample media.
NA - No State of Idaho Water Quality Criterion available.
<u>0.005</u> Bold, Italic, Underline - Concentration exceeds the State of Idaho Water Quality Standard.
Lab Qualifier: J - Estimated value; U - Not detected above the Method Detection Limit

Table 3-5
Groundwater Monitoring Locations and Sample Dates

Monitoring Locations		2018 Groundwater Quality Sampling and Water Level Measurements			
Location ID	**Location Description**	**Winter (Jan-Feb-Mar)**	**Spring (Apr-May-Jun)**	**Summer (Jul-Aug-Sep)**	**Fall (Oct-Nov-Dec)**
Pole Canyon Creek					
Alluvial Wells					
GW-26	Shallow alluvial well downgradient of Pole Canyon ODA upstream of bypass pipeline outlet	--	2018-05-15	--	2018-10-29
GW-15	Shallow alluvial well downgradient of Pole Canyon ODA downstream of bypass pipeline outlet	--	2018-05-15	--	2019-10-29
Wells Formation Bedrock Wells					
GW-16	Wells Formation bedrock well downgradient of Pole Canyon ODA and upgradient of bypass pipeline discharge	--	2018-05-15	--	2018-10-29
Northern Sage Valley					
Alluvial Wells					
GW-22 (98 FT)	Deep alluvial well near Lower Pole Canyon Creek on the western edge of Sage Valley	--	2018-05-15	--	2018-10-29
GW-22 (150 FT)	Deep alluvial well near Lower Pole Canyon Creek on the western edge of Sage Valley	--	2018-05-15	--	2018-10-29

Notes:

-- Sample collection not required.

Table 3-6
Groundwater Monitoring Results

Well ID	Date	Field Parameters					Laboratory Parameters				
		Temperature (°C)	pH (S.U.)	Specific Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Alkalinity Total as $CaCO_3$ (mg/L)	Selenium Dissolved (mg/L)	Selenium[1] Total (mg/L)	Sulfate[2] (mg/L)	TDS[2] (mg/L)
State of Idaho Ground Water Quality Standards		NA	NA	NA	NA	NA	NA	NA	***0.05***	***250***	***500***
Pole Canyon Creek											
Alluvial Wells											
GW-26	2018-05-15	8.27	7.2	1525	7.63	30.6	217	1.5	***1.74***	***646***	***1140***
	2018-10-29	7.02	7.65	1693.8	6.06	1.53	227	2.08	***2.2***	***734*** J	***1310***
GW-15	2018-05-15	6.14	7.44	468.3	9.59	2.45	190	0.102	***0.118***	57.9	272
	2018-10-29	6.97	7.9	416.9	8.27	0.82	197	0.0243	0.0247	21.1 J	226
Wells Formation Bedrock Wells											
GW-16	2018-05-15	6.29	7.51	776.9	9.63	1.66	219	0.566	***0.646***	206	***510***
	2018-10-29	6.13	7.9	759.2	9.79	1.01	219	0.547	***0.543***	186 J	476
Northern Sage Valley											
Alluvial Wells											
GW-22 (98 FT)	2018-05-15	7.79	7.59	402.3	8.39	1.97	173	0.086	***0.101***	37.5	229
	2018-10-29	7.12	8.1	425.5	10.38	1.94	180	0.0933	***0.0957***	36.7 J	247
GW-22 (150 FT)	2018-05-15	7.51	7.78	383	8.29	1.54	175	0.0385	0.0453	19.7	219
	2018-10-29	7.17	8.06	383.8	9.26	1.96	176	0.0372	0.0372	17 J	222

Notes:

°C - degrees Celsius
S.U. - Standard units
mg/L - milligrams per liter
NTU - Nephelometric Turbidity Unit
TDS - Total Dissolved Solids
µmhos/cm - micro mhos per centimeter
1. State of Idaho Ground Water Quality Rule (IDAPA 58.01.11), primary standards for drinking water .
2. Secondary standards for drinking water (non-enforceable guidelines based on aesthetic or cosmetic effects rather than health).
NA - No State of Idaho Ground Water Quality Standard available.
Data Quality Review Qualifier: J - Estimated value
0.005 Bold, Italic, Underline - Concentration exceeds the State of Idaho Ground Water Quality Standard.

Table 3-7
Selenium Concentrations in Forage Vegetation

Zone (Sample ID)	Location Description	Selenium (mg/kg)	Forage Sample Species (% Composition)
Zone 1 (PCO-15)	East side west-facing slope at top of Pole Canyon ODA	0.037 J	ELYLAN (45.6), EPIBRA (25.8), LAPOCC (10), BROMAR (6.8), DACGLO (6.6), CAPBUR (3), LACSER (2), ACHMIL (0.2)
Zone 2 (PCO-16)	East side flat area at top of Pole Canyon ODA	0.246	MELOFF (16), TRIAESxSECCER (10), RUMSPP (10), ACHMIL (10), EPIBRA (8), DACGLO (8), BROMAR (8), POLAVI (8), LACSER (8), ANTCOT (8), LAPOCC (6)
Zone 3 (PCO-17)	East-facing slope above east sedimentation basin	0.057	DACGLO (54.46), SANMIN (27), FESSAX (11.86), ACHMIL (6.66)
Zone 4 (PCO-18)	East side south-facing slope above south-central sedimentation basin	0.034 J	ELYTRA (44.8), EPIBRA (21), DACGLO (14), POASEC (10), FESSAX (9.8), LACSER (0.4)
Zone 5 (PCO-19)	West side slope above south sedimentation basin	0.02 U	ACHMIL (28), ELYLAN (44), ELYTRA (10), DACGLO (18)
Zone 6 (PCO-20)	West side slope above west infiltration basin	0.114	DACGLO (37.6), EPIBRA (30.2), CAPBUR (10), ACHMIL (10), BROMAR (5), POASEC (5), FESSAX (2), LACSER (0.2)
	Overall Average	0.085	

Notes:

mg/kg - milligrams per kilogram

Lab Qualifiers: J - Estimated value; U - Not detected above the Method Detection Limit

Vegetation samples collected July 17, 2018.

Grass Veg Code	Scientific Name	Common Name
BROMAR	*Bromus marginatus*	Mountain brome
DACGLO	*Dactylis glomerata*	Orchard grass
ELYLAN	*Elymus lanceolatus*	Thickspike w heatgrass
ELYTRA	*Elymus trachycaulus*	Slender w heatgrass
FESSAX	*Festuca saximontana*	Rocky Mtn fescue
POASEC	*Poa secunda*	Big bluegrass
TRIAESx SECCER	*Triticum aestivum x Secale cereal*	Sterile w heat

Forb Veg Code	Scientific Name	Common Name
ACHMIL	*Achillea millefolium*	Common yarrow
ANTCOT	*Anthemis cotula*	Stinking chamomile
CAPBUR	*Capsella bursa-pastoris*	Shepherd's purse
EPIBRA	*Epilobium brachycarpum*	Tall annual w illow herb
LACSER	*Lactuca serriola*	Prickly lettuce
LAPOCC	*Lappula occidentalis*	Flatspine stickw eed
MELOFF	*Melilotus officinalis*	Yellow sw eet clover
POLAVI	*Polygonum aviculare*	Prostrate knotw eed
RUMSPP	*Rumex* spp.	Dock
SANMIN	*Sanguisorba minor*	Small burnet

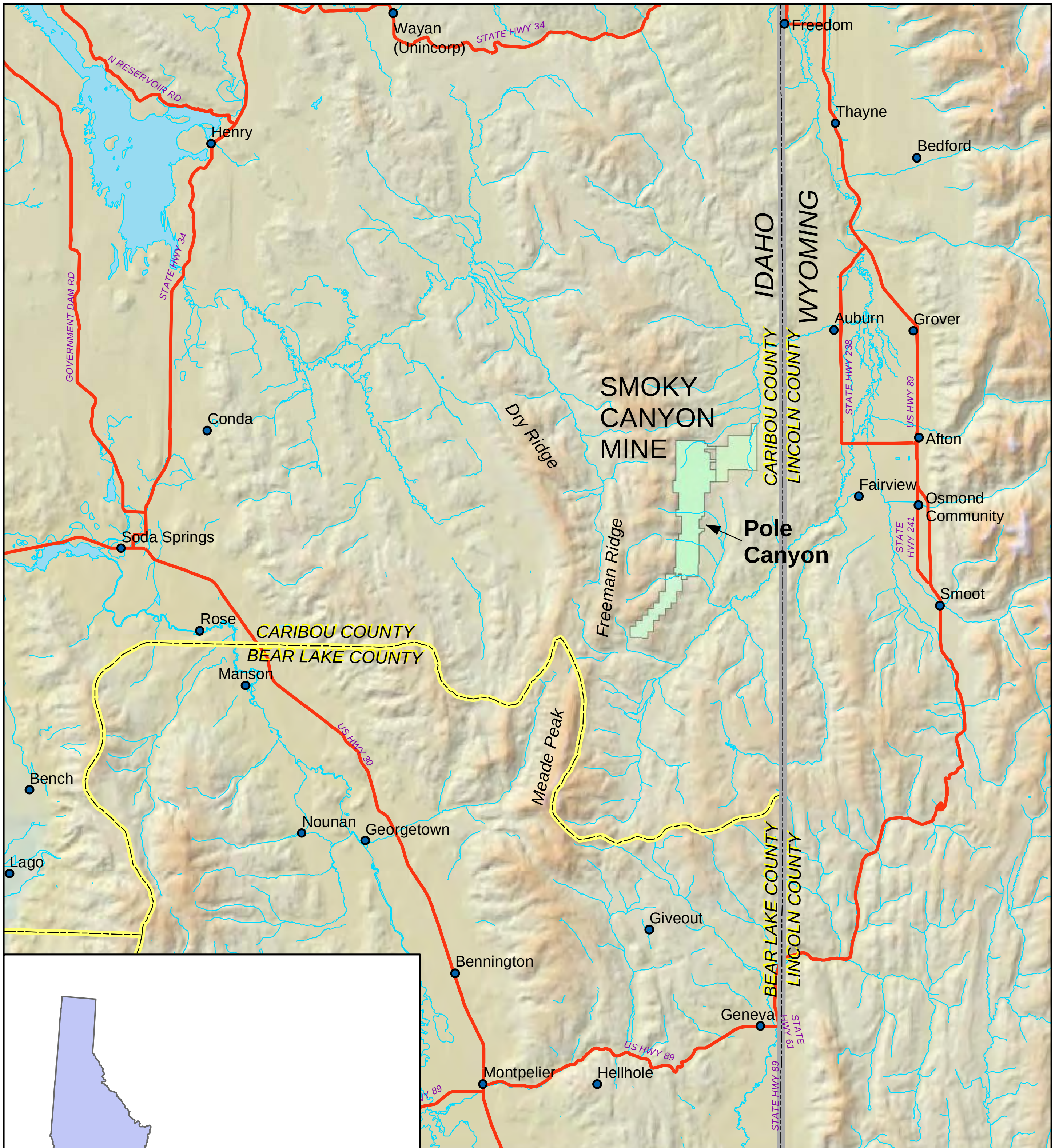
Table 3-8
Summary of Vegetation/Ground Cover Estimates

Zone	Bare Ground	Litter	Rock	Vegetation
Zone 1	21%	5%	26%	48%
Zone 2	58%	0%	25%	17%
Zone 3	30%	7%	15%	48%
Zone 4	18%	16%	15%	51%
Zone 5	19%	13%	29%	39%
Zone 6	6%	5%	66%	23%

Notes:

Vegetation community measurements collected July 17, 2018.

FIGURES



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SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 1-1

LOCATION OF THE SMOKY CANYON MINE AND POLE CANYON

DATE: JULY 2019

BY: CRL FOR: ACK

FORMATION ENVIRONMENTAL

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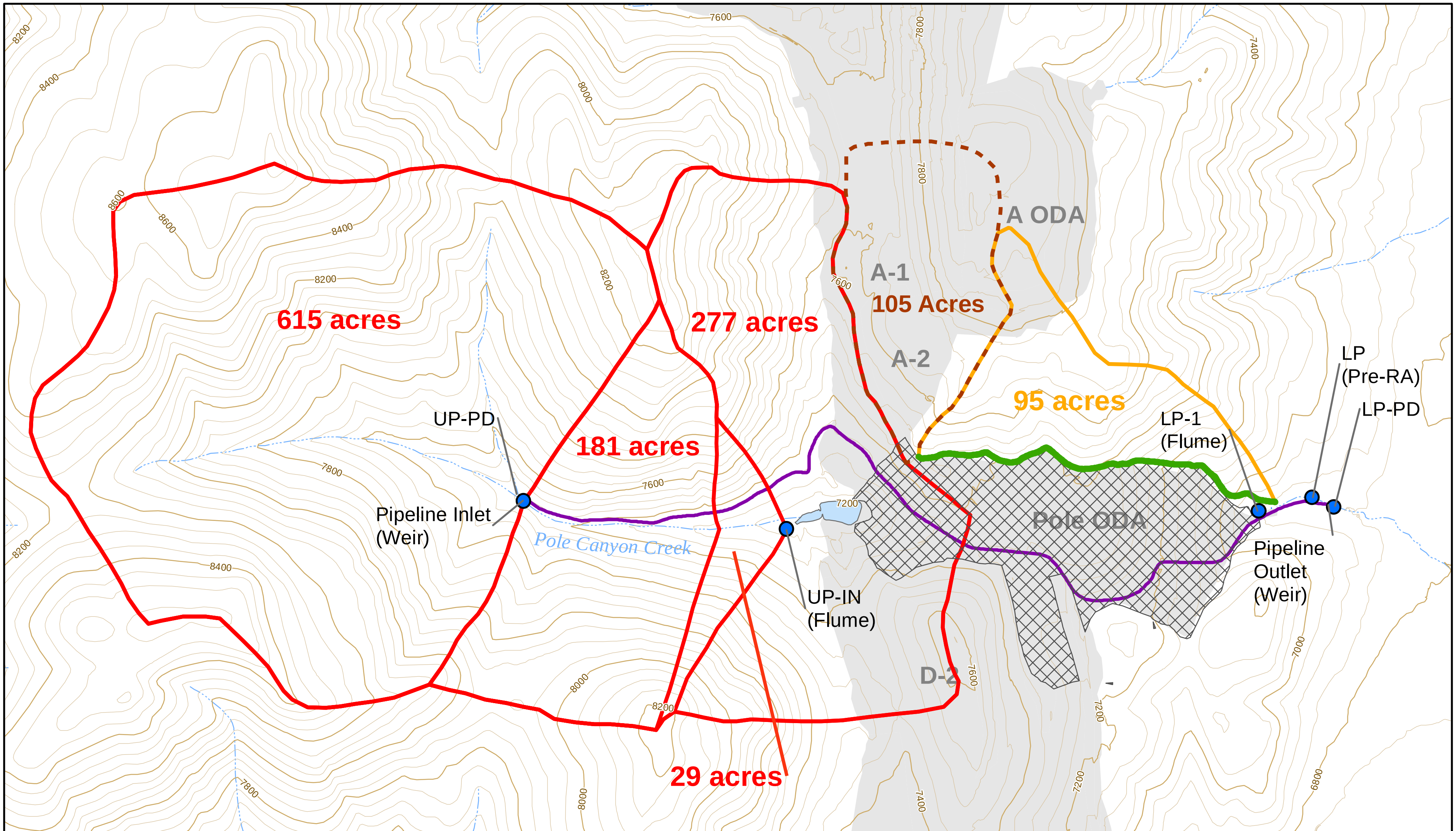
S:\GIS\ARCPRJ2\010109\PLT\EFFECTIVENESSMONPLAN\2018ANNUALRPT\FIG1_2_POLEFLOWLOCS.MXD



Legend

Flume and Weir Locations		Bypass Pipeline (2006 NTCRA)	
Drainage Area for Runoff from Panel A Reclaimed Area		Run-on Control Channel (2006 NTCRA)	
Pole Canyon ODA 2013 NTCRA Cover Area		Sedimentation/Infiltration Basin (2006 NTCRA)	
Upper Pole Canyon Creek Watershed		Mine Disturbance Areas	
Run-on Control Channel Watershed		**NTCRA = Non-Time-Critical Removal Action**	

N

0 1,000 2,000

Feet

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SMOKY CANYON MINE

2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 1-2

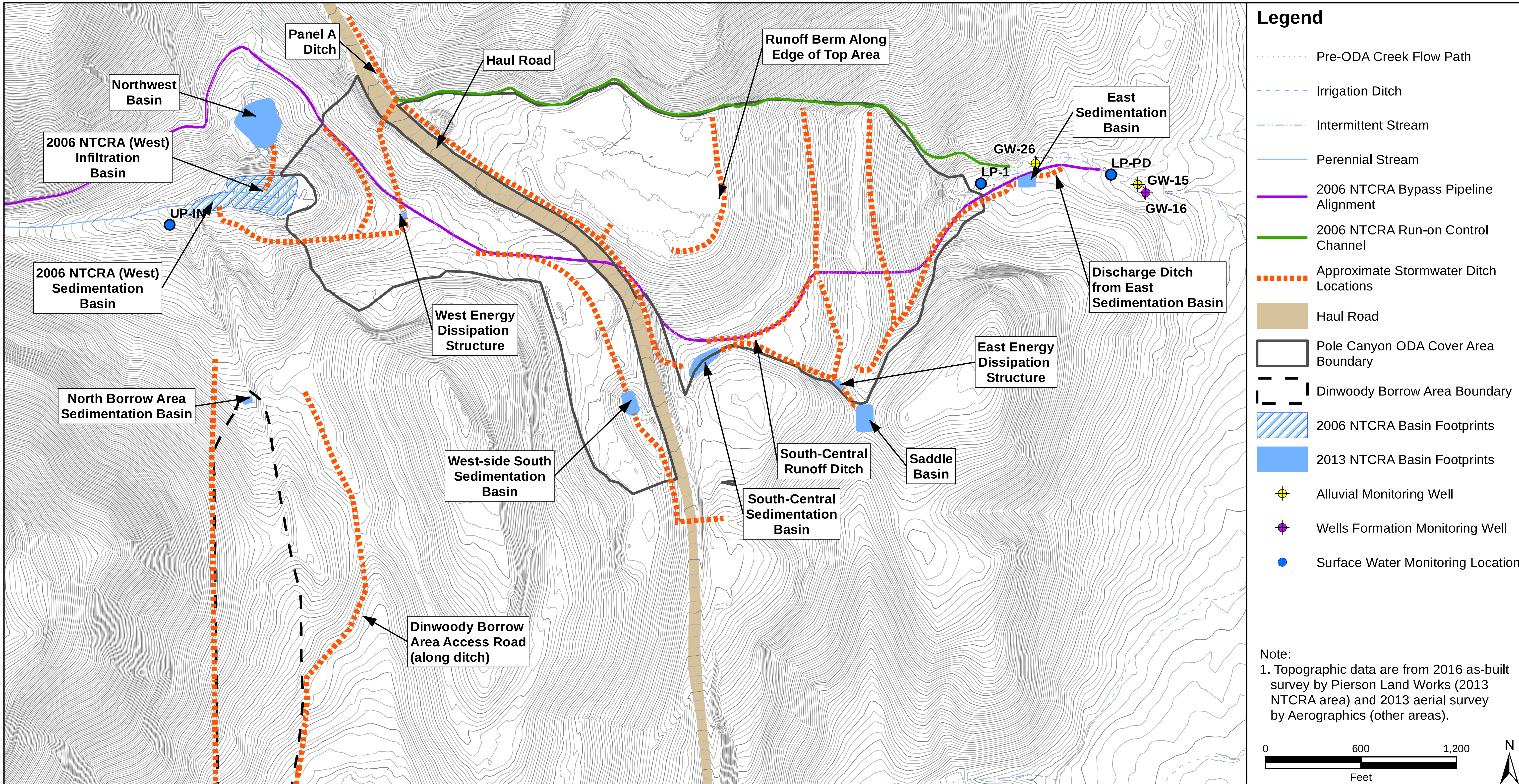
UPPER POLE CANYON CREEK WATERSHED AND 2006 NTCRA COMPONENTS

DATE: JULY 2019

BY: CRL

FOR: ACK

FORMATION ENVIRONMENTAL



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SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 1-3

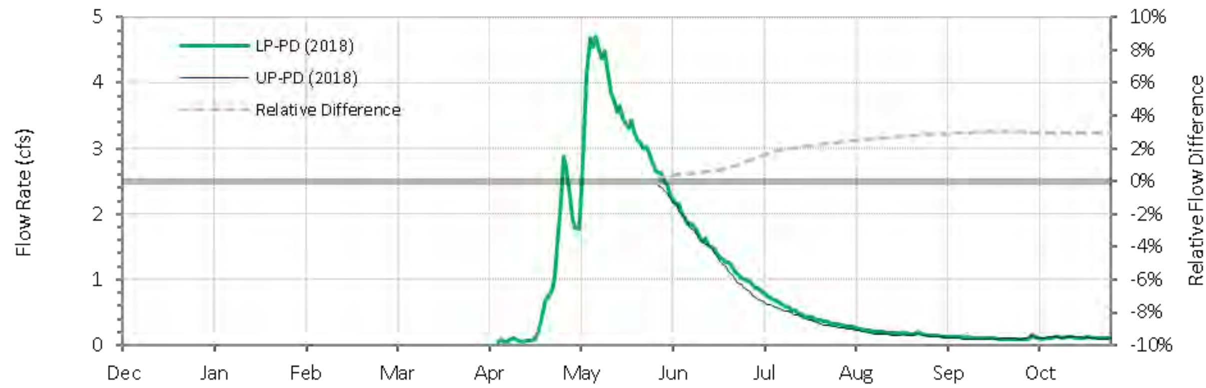
POLE CANYON
2006 NTCRA AND 2013 NTCRA COMPONENTS

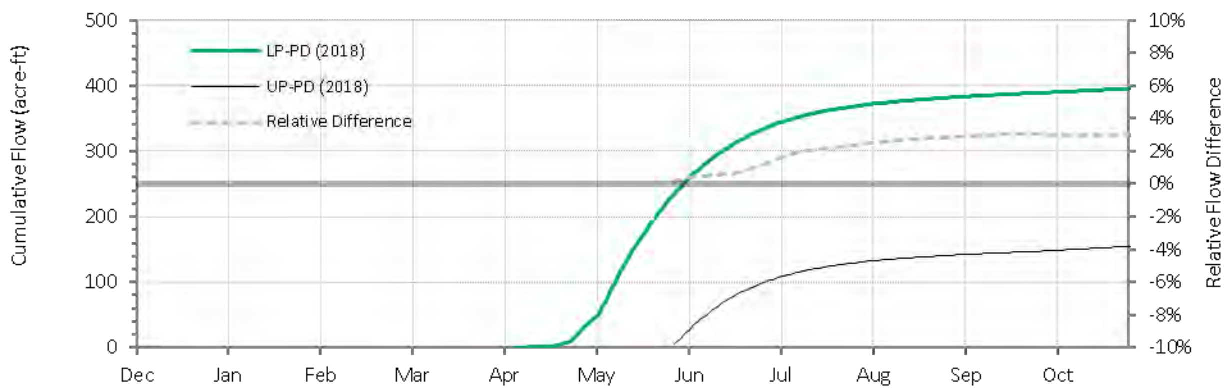
DATE: JULY 2019
BY: CRL | FOR: ACK

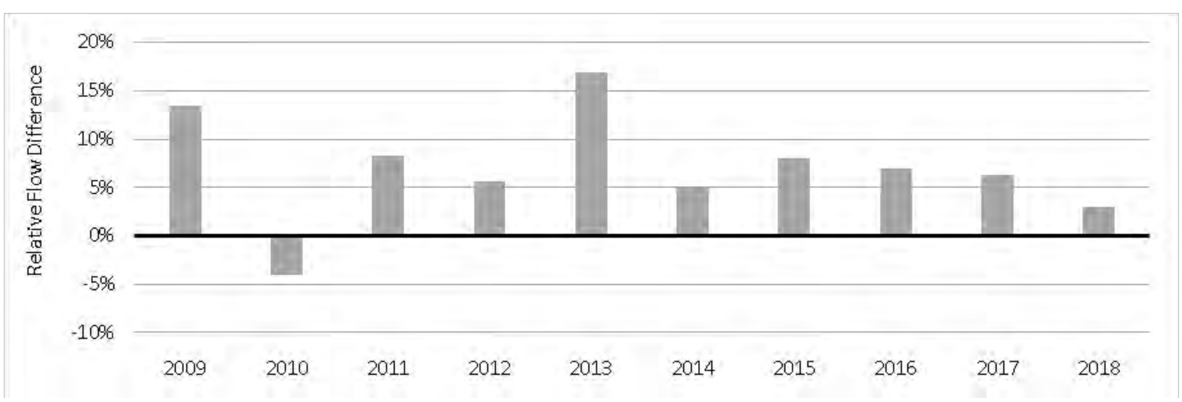
FORMATION ENVIRONMENTAL

S:\GIS\arcprj\2010109\plt\EffectivenessMonPlan\2018AnnualRpt\Fig1_3_Pole_NTCRA_2016_2013.mxd

"S:\JOBS\SMOKY\CERCLA\POLENTCRA\ANNRPT\2018\DRAFT\FIGURES\FIGSPORTRAIT_2018.PPTX"







Notes:

1. Relative flow difference is based on total volume discharged over the year, as measured at the LP-PD weir. A positive difference indicates more water was calculated discharging from the pipeline than entering at the inlet.
2. Pipeline flow data is unavailable from December 2017 to April 2018. Streamflow began bypassing the pipeline inlet in December 2017 and flowed to the infiltration basin. As flows increased, streamflow resumed flowing through the pipeline in April 2018. Repairs were made to the inlet in July 2018 by filling a hole beneath the structure with about 100 pounds of granular bentonite.
3. Cumulative flow difference calculated for period when transducers at both LP-PD and UP-PD were operational.

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2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

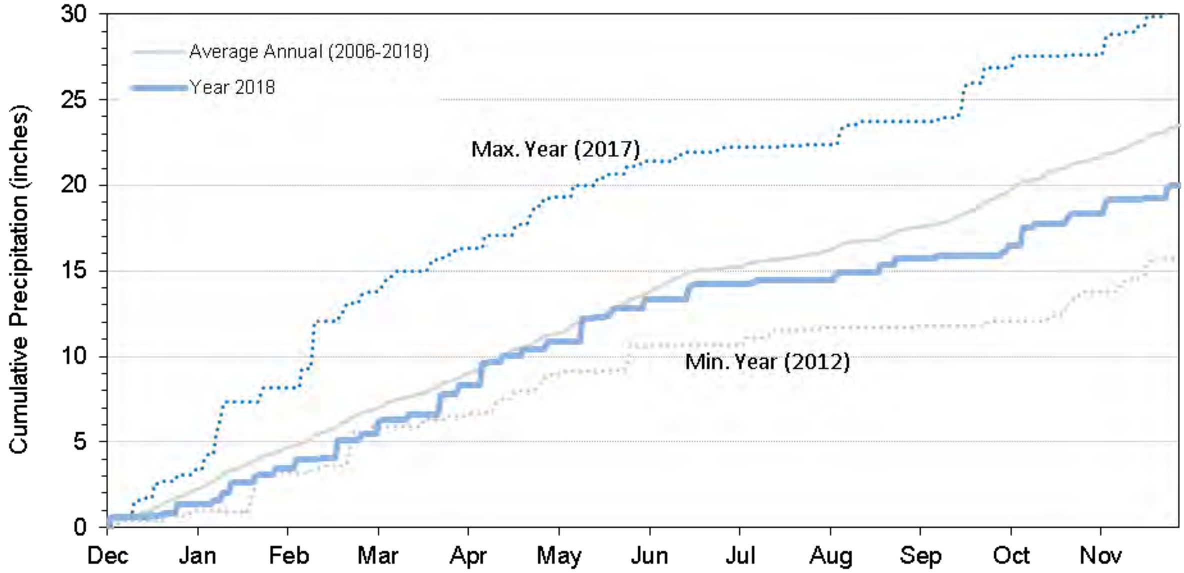
FIGURE 2-1

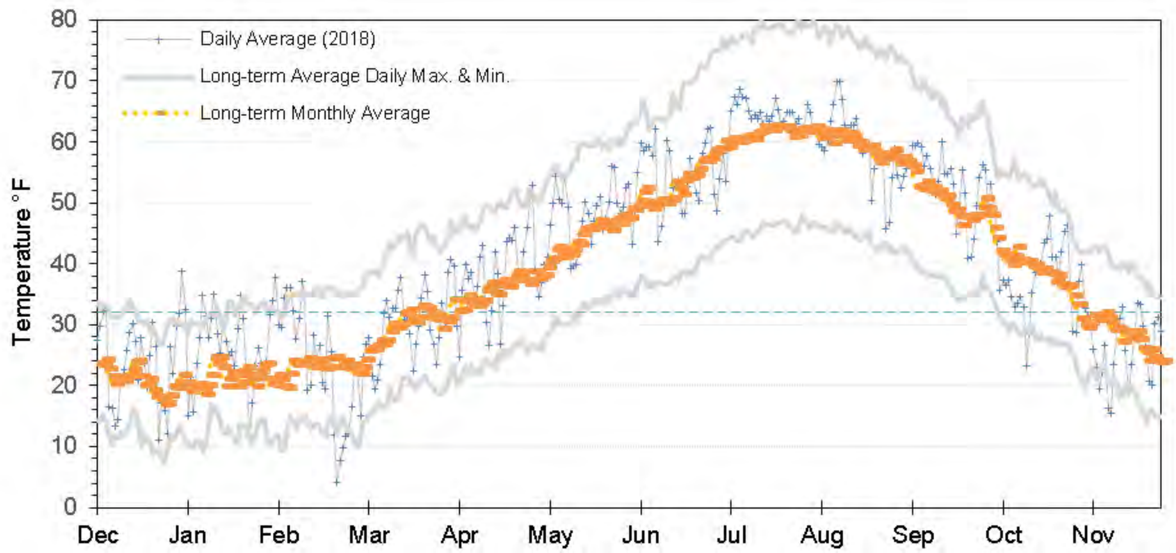
BYPASS PIPELINE INFLOW/OUTFLOW COMPARISON

DATE: JULY 2019		FORMATION ENVIRONMENTAL
BY: LJM	FOR: ACK	

"S:\Jobs\Smoky\CERCLA\PoleNTCRA\AnnRpt\2018\Draft\Figures\tbl_DailyFlow_ALL_Pipeline_2018.xlsx"

"S:\JOBS\SMOKY\CERCLA\POLENTCRA\ANNRPT\2018\DRAFT\FIGURES\FIGSPORTRAIT_2018.PPTX"





Notes:
1. Precipitation data were collected at the Guard Shack through June 21, 2011.
2. Precipitation data from June 2011 to December 2013 were estimated from the Slug Creek Divide SNOTEL Station precipitation data and monthly manual measurements collected at the Guard Shack.
3. Manual precipitation data were collected at the Security Building from 2014 to present.
4. Long-term temperature data are from 1984-2018, Slug Creek SNOTEL.

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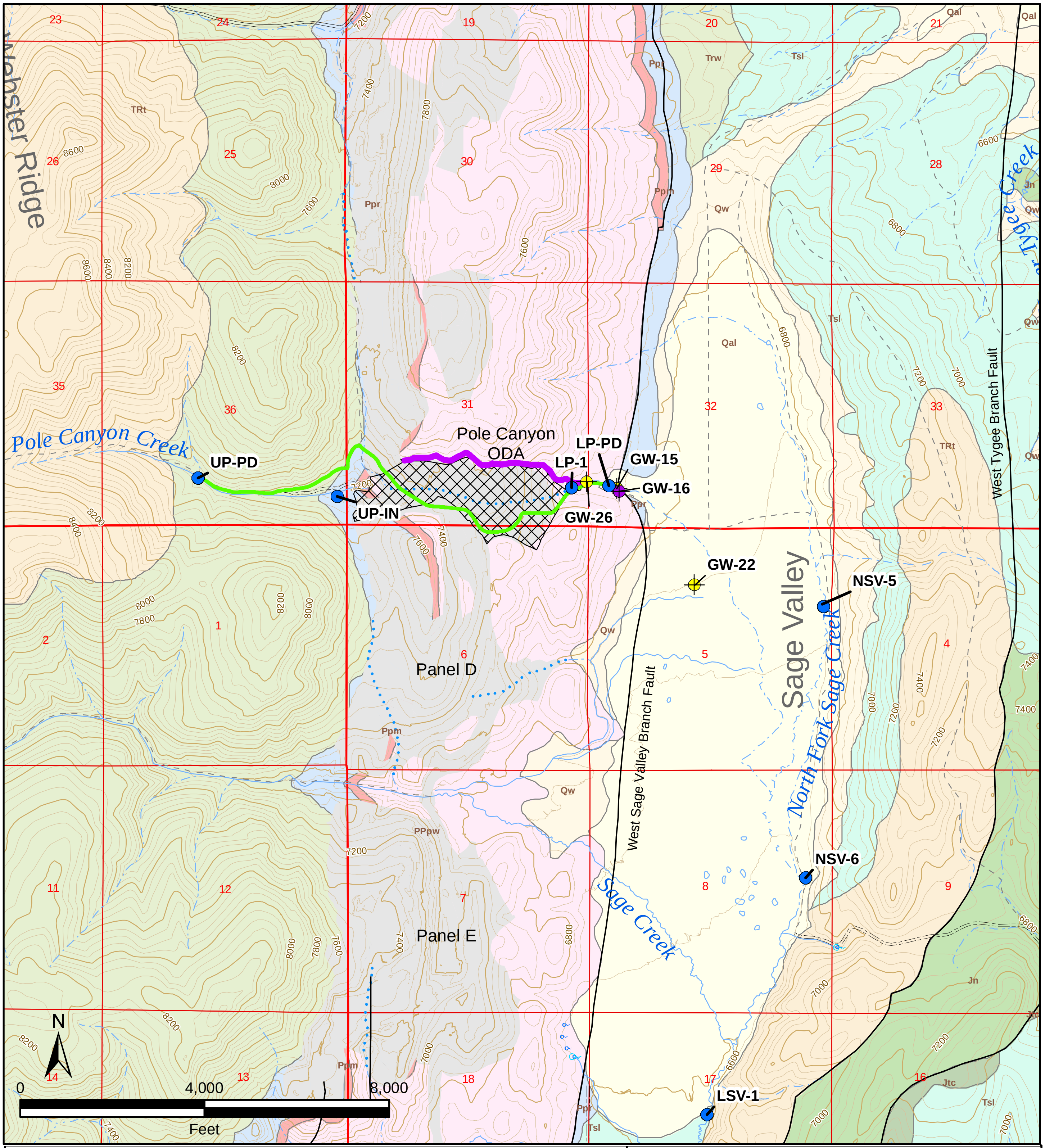
FIGURE 3-1

CUMULATIVE PRECIPITATION AND TEMPERATURE AT SMOKY CANYON MINE

DATE: JULY 2019
BY: LJM | FOR: ACK

FORMATION ENVIRONMENTAL

"S:\Jobs\Smoky\CERCLA\PolENTCRA\AnnRpt\2018\Draft\Figures\MetDataSummary2018.xlsx"



Legend

- Surface Water Monitoring Locations
- Alluvial Monitoring Wells
- Wells Formation Monitoring Wells
- Pole Canyon Creek Bypass Pipeline
- Run-on Control Channel
- Dinwoody/Chert Cover on Pole Canyon ODA (120 acres)
- Mine Disturbance Areas

Notes:
1. Mine disturbance area boundary includes a 50-foot buffer.
2. Topographic surface reflects 2004 conditions in mine disturbance areas.
3. Surface geology is from Mansfield (1927).

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2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 3-2

MONITORING LOCATIONS

DATE: JULY 2019	
BY: CRL	FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\EffectivenessMonPlan\2018AnnualRpt\Fig3_2_EffSWLocs.mxd

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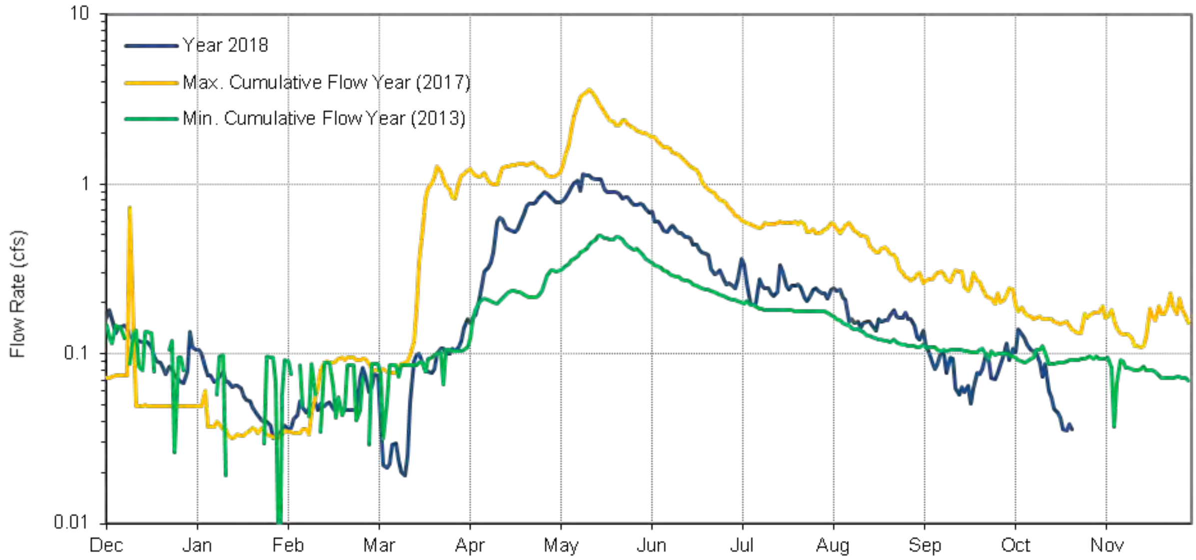

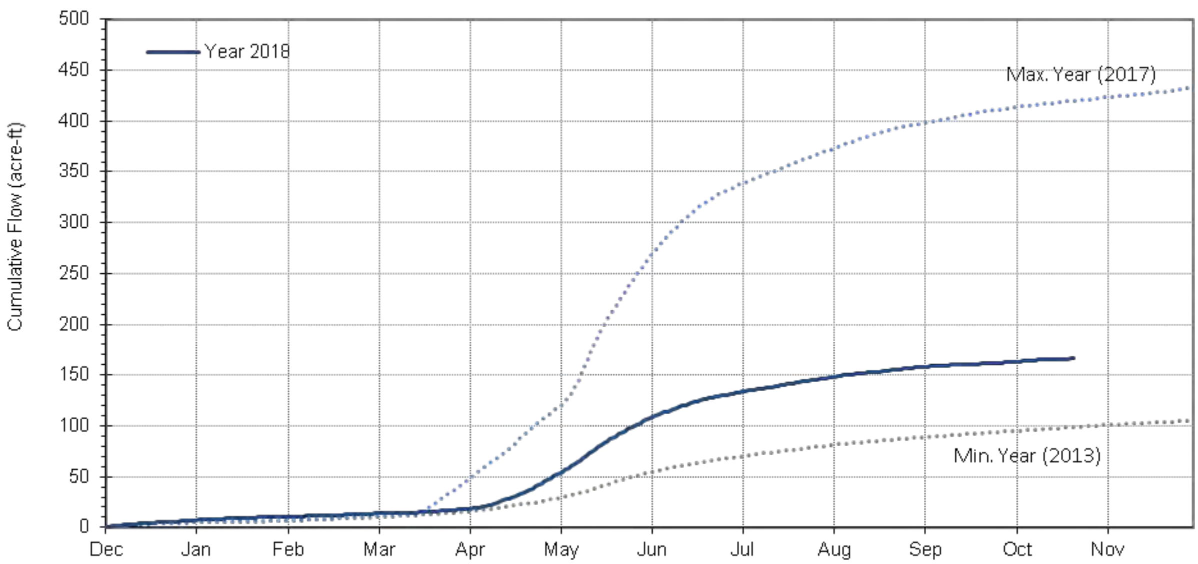

Notes:

1. Flows less than approximately 0.01 cfs correspond to water depths in the flume of less than 0.25 inches. These flows are considered less reliable due to potential measurement errors at low flows.

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FIGURE 3-3

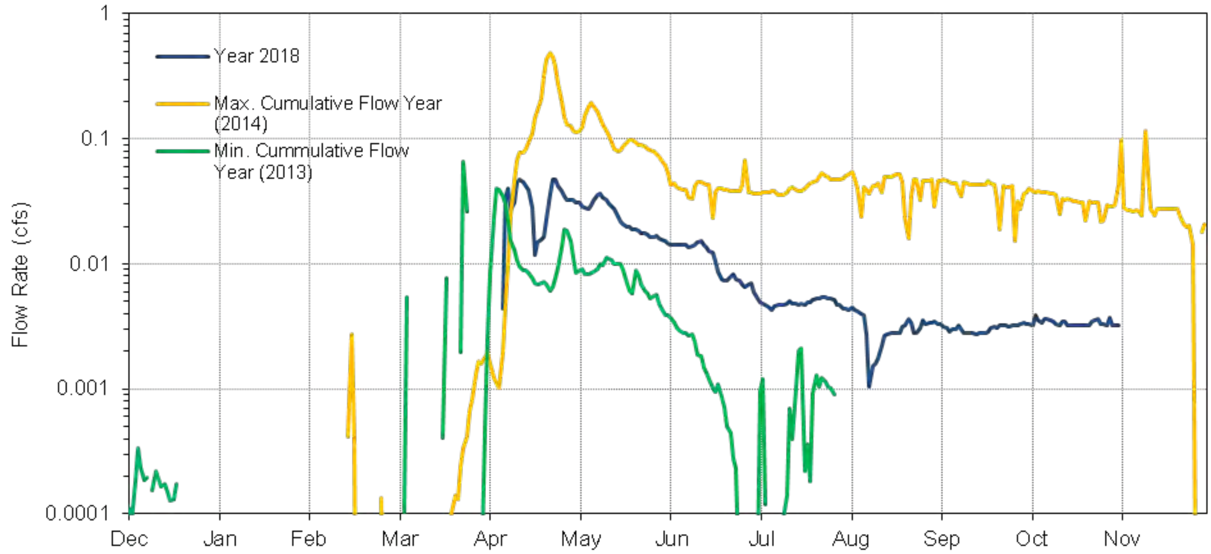
ANNUAL HYDROGRAPH FOR STATION UP-IN (UPSTREAM OF THE INFILTRATION BASIN)

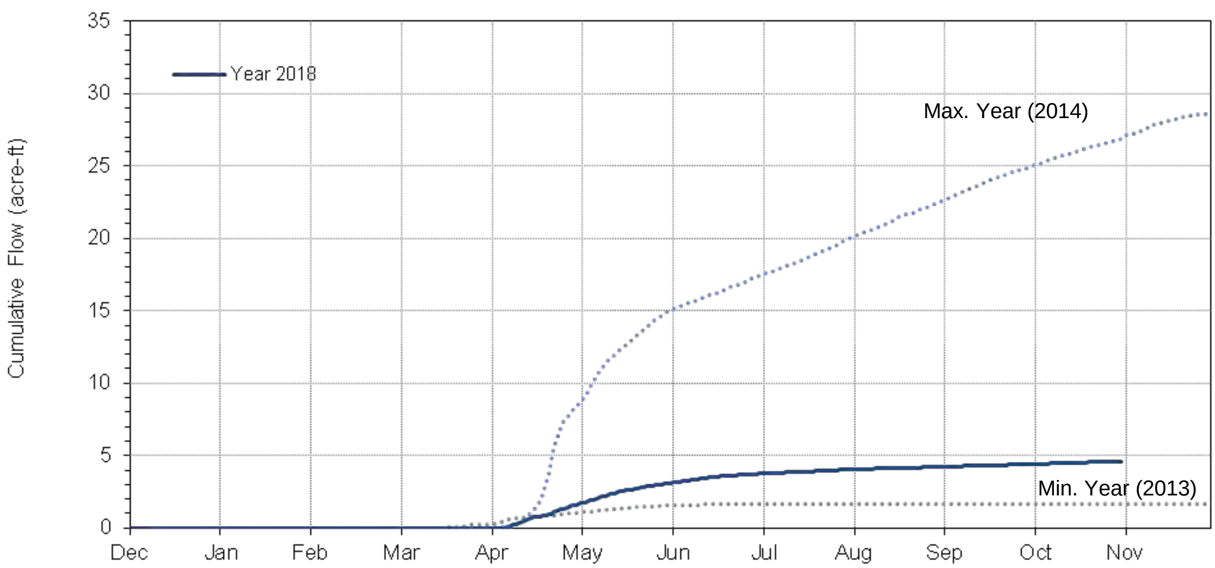
DATE: JULY 2019

BY: LJM | FOR: ACK

FORMATION ENVIRONMENTAL

"S:\Jobs\Smoky\CERCLA\PoleNTCRA\AnnRpt\2018\Draft\Figures\Hydrographs_UPIN_LP1_2018.xlsx"





Notes:

1. Flows less than approximately 0.01 cfs correspond to water depths in the flume of less than 0.25 inches. These flows are considered less reliable due to potential measurement errors at low flows.

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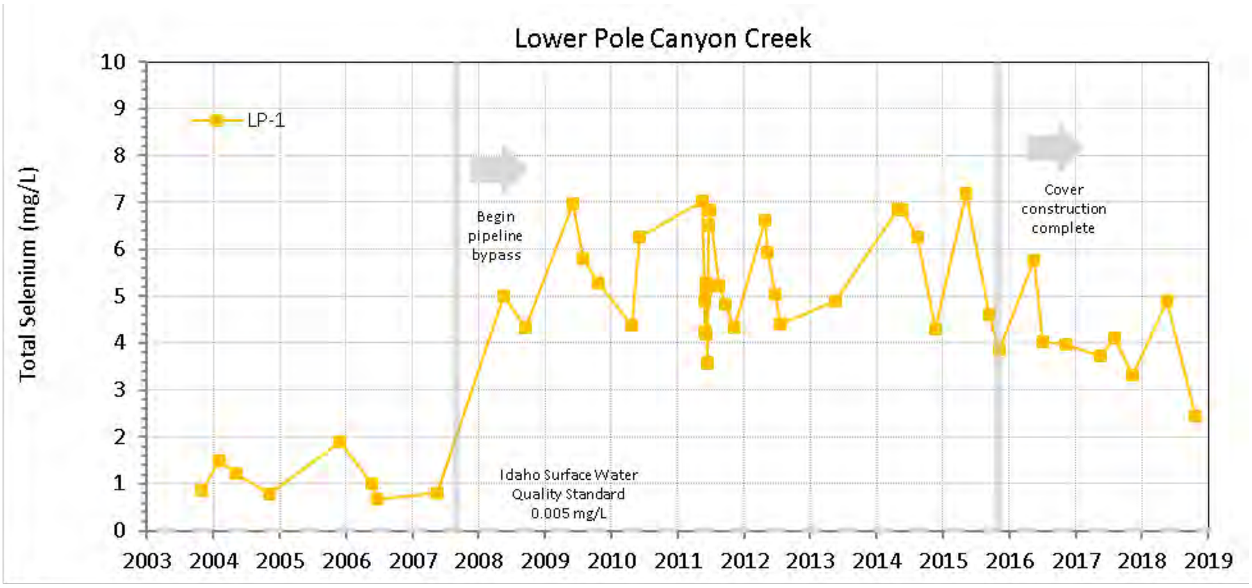
FIGURE 3-4

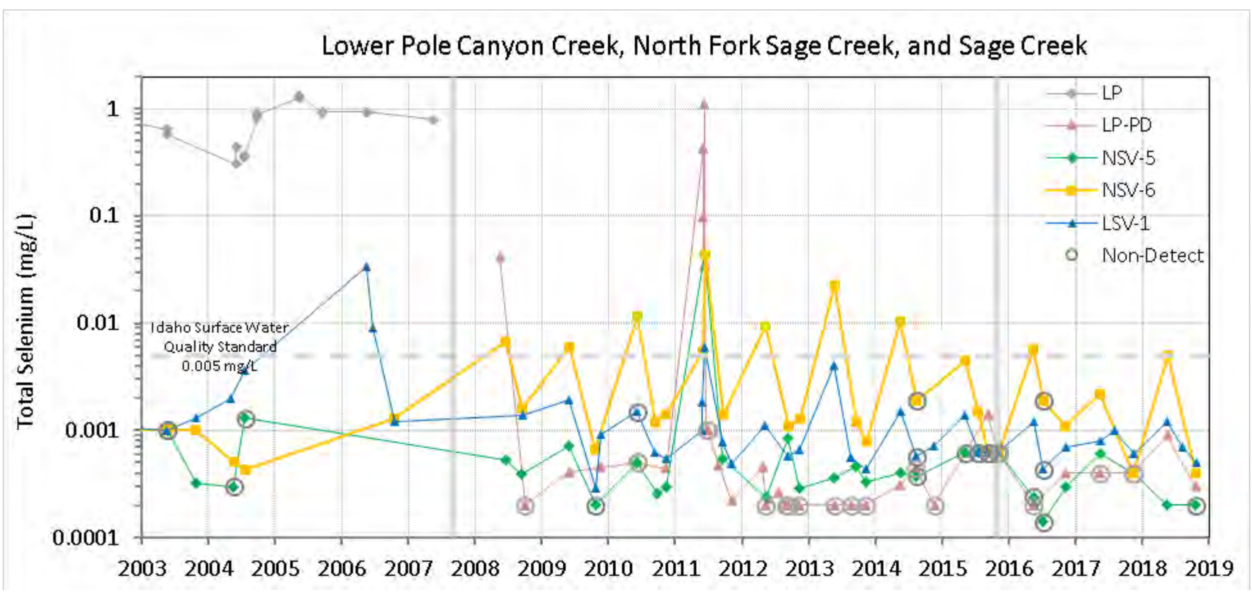
ANNUAL HYDROGRAPH FOR STATION LP-1 (AT TOE OF ODA)

DATE: JULY 2019

BY: LJM FOR: ACK

FORMATION ENVIRONMENTAL





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2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 3-5

TOTAL SELENIUM CONCENTRATIONS IN LOWER POLE CANYON CREEK, NORTH FORK SAGE CREEK, AND SAGE CREEK

DATE: JULY 2019		FORMATION ENVIRONMENTAL
BY: LJM	FOR: ACK	

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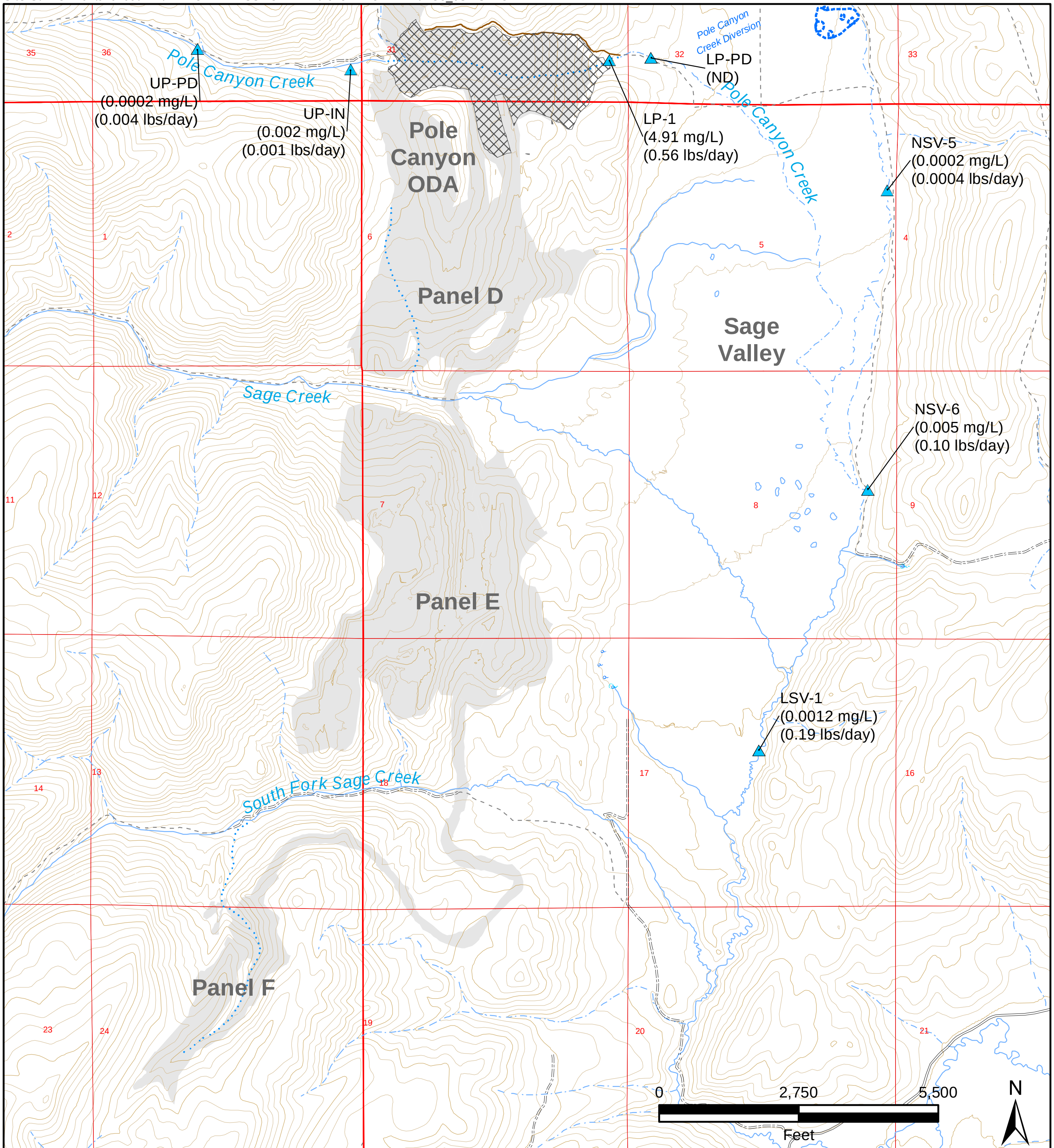
S:\GIS\ARCPRJ2\010109\PLT\EFFECTIVENESSMONPLAN\2018ANNUALRPT\FIG3_6SWSELOAD.MXD



Legend

Surface Water Monitoring Locations

Dinwoody/Chert Cover on Pole Canyon ODA (140 acres)

Mine Disturbance Areas

Notes:
1. Topographic surface reflects 2004 conditions in mine disturbance areas.
2. Surface water total selenium concentrations and loading were calculated for May 14-18, 2018.

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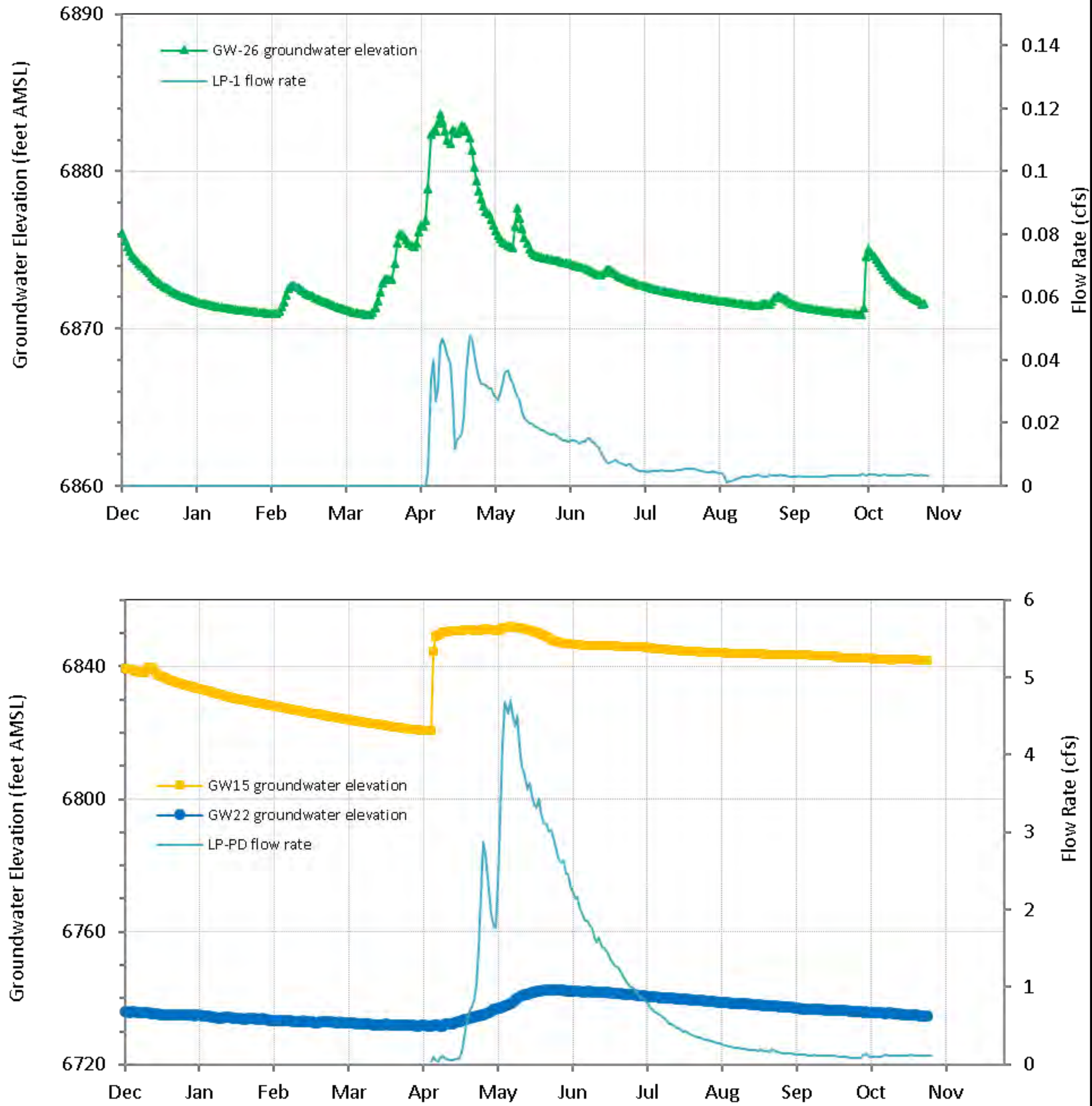
SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 3-6
SURFACE WATER TOTAL SELENIUM CONCENTRATIONS AND LOADING (MAY 2018)

DATE: JULY 2018
BY: LJM
FOR: ACK

FORMATION ENVIRONMENTAL



Notes:

1. Flows less than approximately 0.01 cfs correspond to water depths in the flume of less than 0.25 inches. These flows are considered less reliable due to potential measurement errors at low flows.
2. LP-PD flow data is unavailable from December 2018 to April 2018. Streamflow began bypassing the pipeline inlet in December 2017 and flowed to the infiltration basin. As flows increased, streamflow resumed flowing through the pipeline in April 2018. Repairs were made to the inlet in July by filling a hole beneath the structure with about 100 pounds of granular bentonite.

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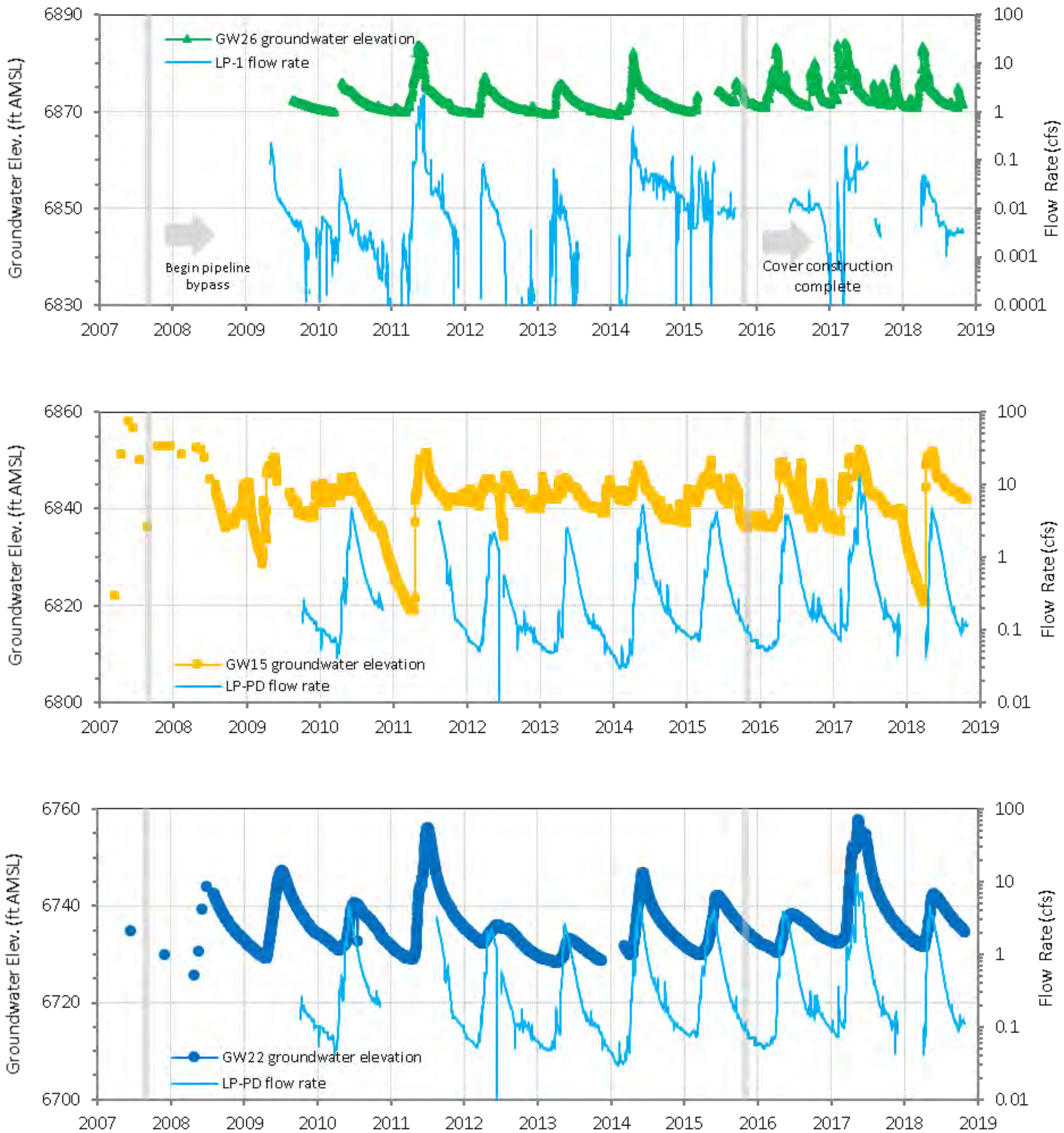
SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 3-7

2018 ALLUVIAL GROUNDWATER ELEVATIONS WITH LP-1 AND LP-PD FLOWS

DATE: JULY 2019		FORMATION ENVIRONMENTAL
BY: LJM	FOR: ACK	

"S:\Jobs\Smoky\CERCLA\PoleNTCRA\AnnRpt\2018\Draft\Figures\PoleHydrographs_GW_2018.xlsx"



Notes:

1. LP-1 transducer vent line became plugged from July 14 through August 16, 2017 and September 15 through November 15, 2018, providing questionable data. Flow rate was estimated using linear interpolation for cumulative flow estimate.
2. LP-PD flow data is unavailable from December 2018 to April 2018. Streamflow began bypassing the pipeline inlet in December 2017 and flowed to the infiltration basin. As flows increased, streamflow resumed flowing through the pipeline in April 2018. Repairs were made to the inlet in July by filling a hole beneath the structure with about 100 pounds of granular bentonite.
3. Flows less than approximately 0.01 cfs correspond to water depths in the flume of less than 0.25 inches. These flows are considered less reliable due to potential measurement errors at low flows.

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2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 3-8

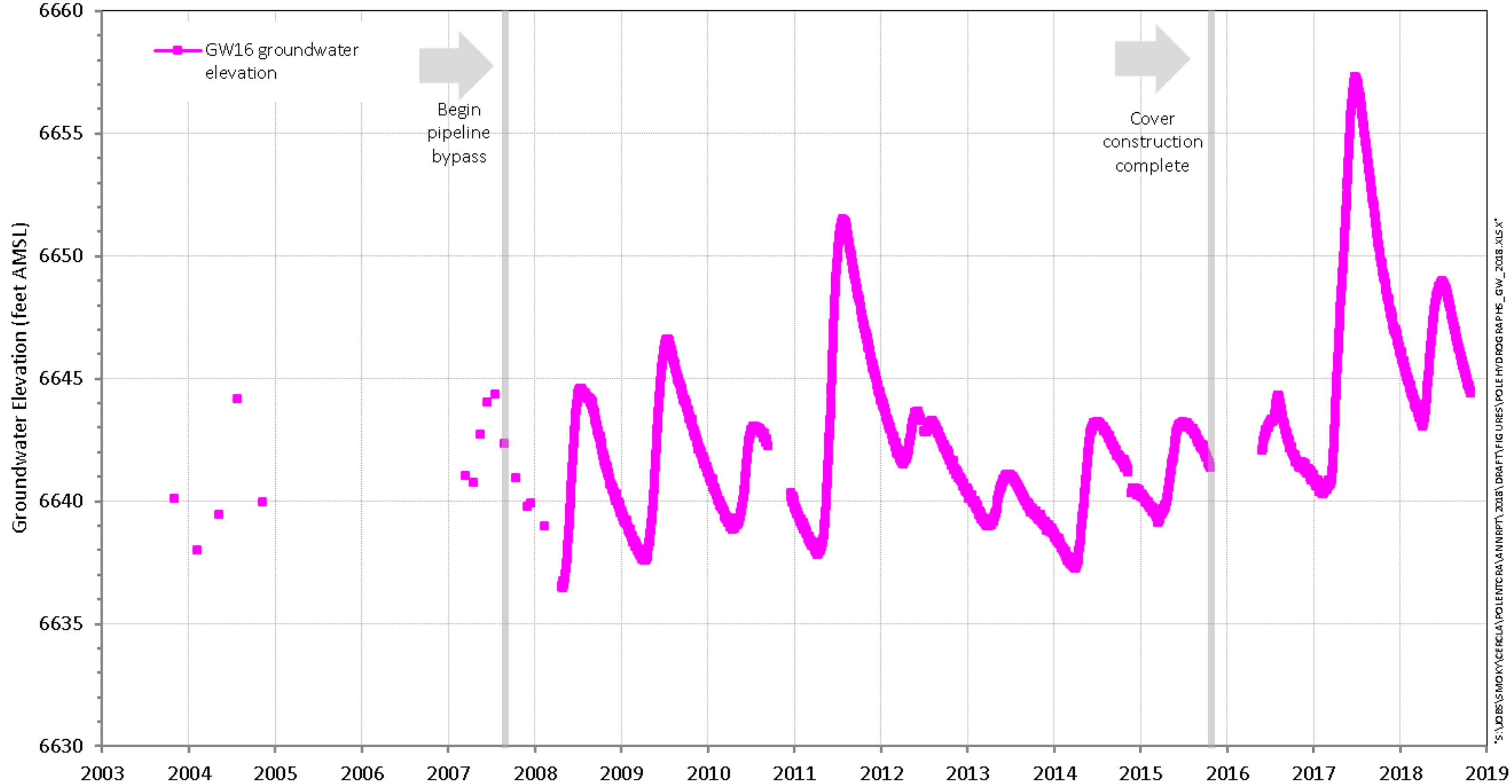
LONG-TERM ALLUVIAL GROUNDWATER ELEVATIONS WITH LP-1 AND LP-PD FLOWS

DATE: JULY 2019

BY: LJM | FOR: ACK

FORMATION ENVIRONMENTAL

"S:\JOBS\SMOKY\CERCLA\POLENTCRA\ANNRPT\2018\DRAFT\FIGURES\FIGSLANDSCAPE_2018.PPTX"



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SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 3-9

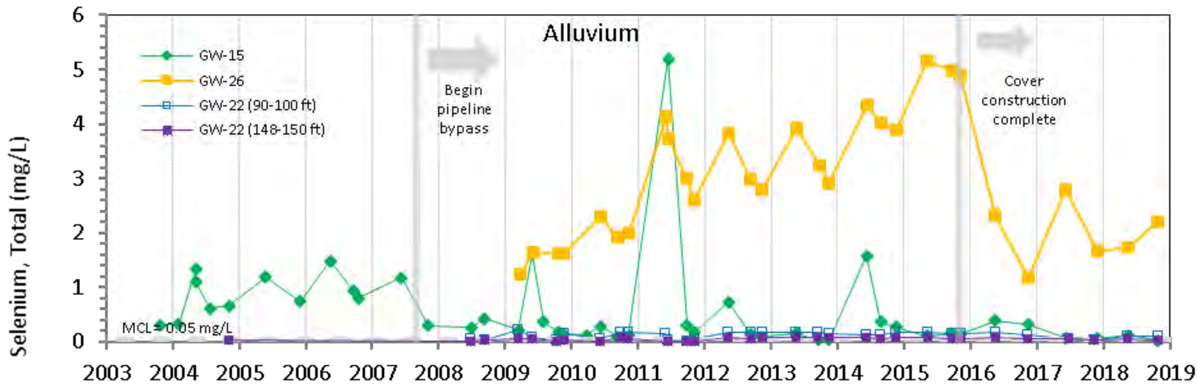
WELLS FORMATION GROUNDWATER ELEVATIONS

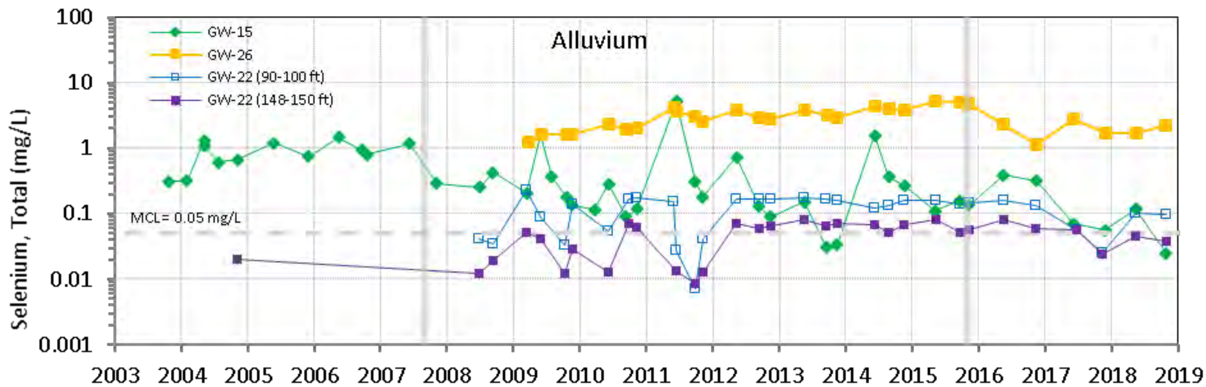
DATE: JULY 2019

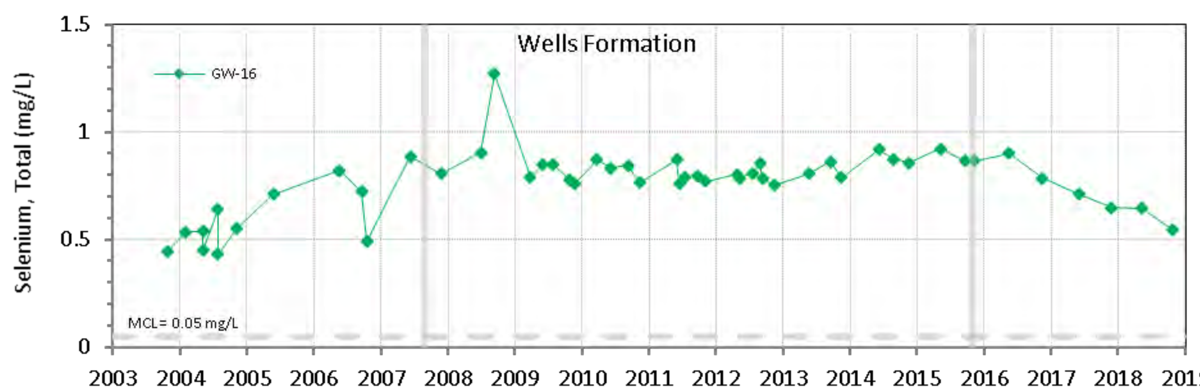
BY: LJM | FOR: AKC

FORMATION ENVIRONMENTAL

Notes:
1. Continuous groundwater elevation monitoring began in April 2008 for GW-16.







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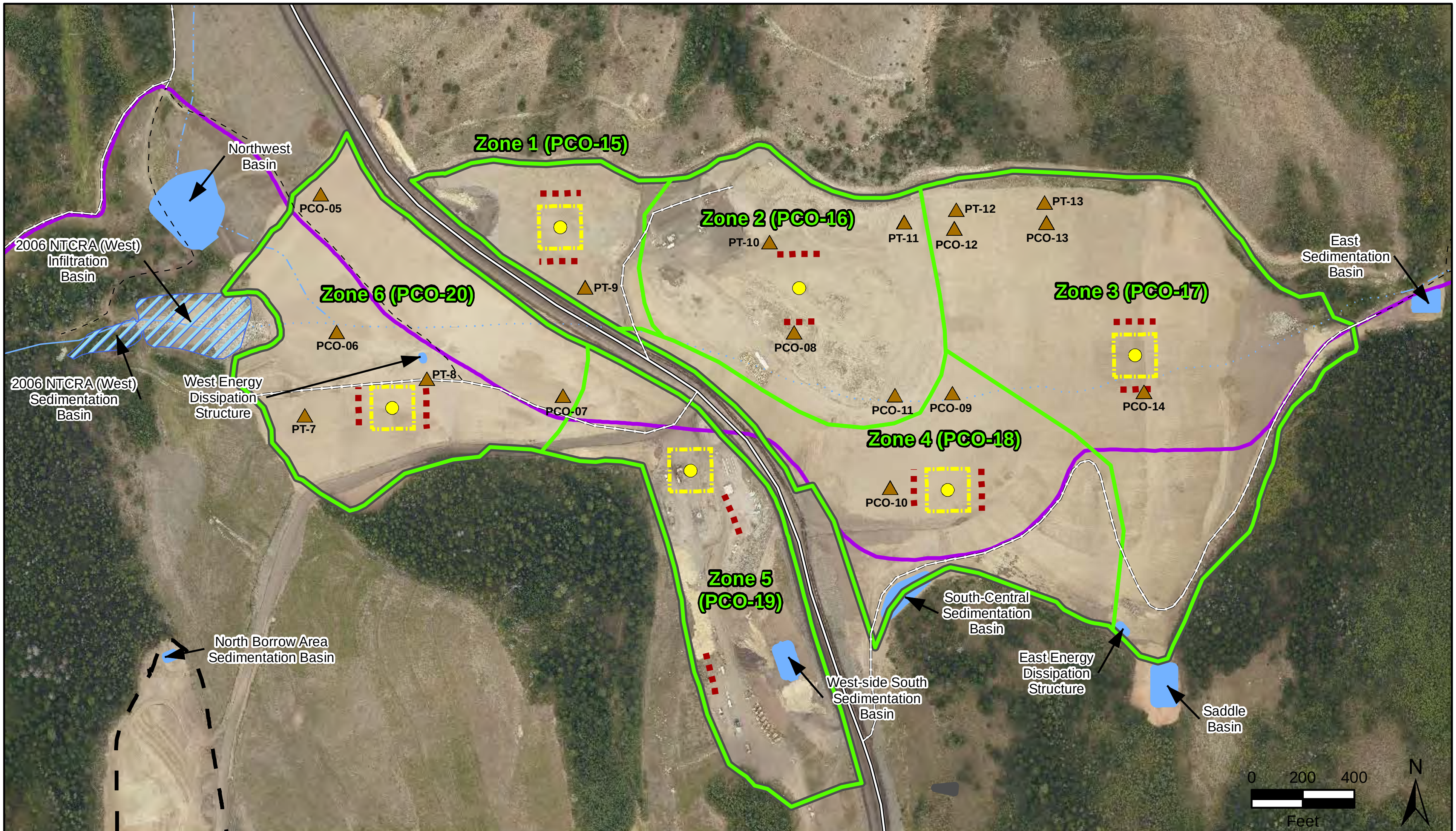
SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 3-10

TOTAL SELENIUM CONCENTRATIONS IN ALLUVIAL AND WELLS FORMATION GROUNDWATER

DATE: JULY 2019		FORMATION ENVIRONMENTAL
BY: LJM	FOR: ACK	

"S:\Jobs\Smoky\CERCLA\PoleNTCRA\AnnRpt\2018\Draft\Figures\SeTimeseries_2018.xlsx"



Legend

- 2006 NTCRA Basin Footprints
- 2013 NTCRA Basin Footprints
- Pre-ODA Creek Flow Path
- Intermittent Stream
- Perennial Stream
- 2006 NTCRA Bypass Pipeline Alignment
- Dinwoody Borrow Area Boundary
- Pole Canyon ODA Cover Area Boundary
- Vegetation Monitoring Zone
- Vegetation Sampling Plot
- Vegetation Sampling Zone Centroid
- Vegetation Monitoring Transect
- Pre-NTCRA Vegetation Sampling Location
- Primary Highway
- Major Road
- Minor Road
- Unimproved Road
- Trail (4WD)
- Trail (Other than 4WD)

Notes:
NTCRA = Non-Time-Critical Removal Action

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SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 3-11

VEGETATION EFFECTIVENESS MONITORING LOCATIONS (JULY 2018)

DATE: JULY 2019

BY: RCR | FOR: MKL

FORMATION ENVIRONMENTAL

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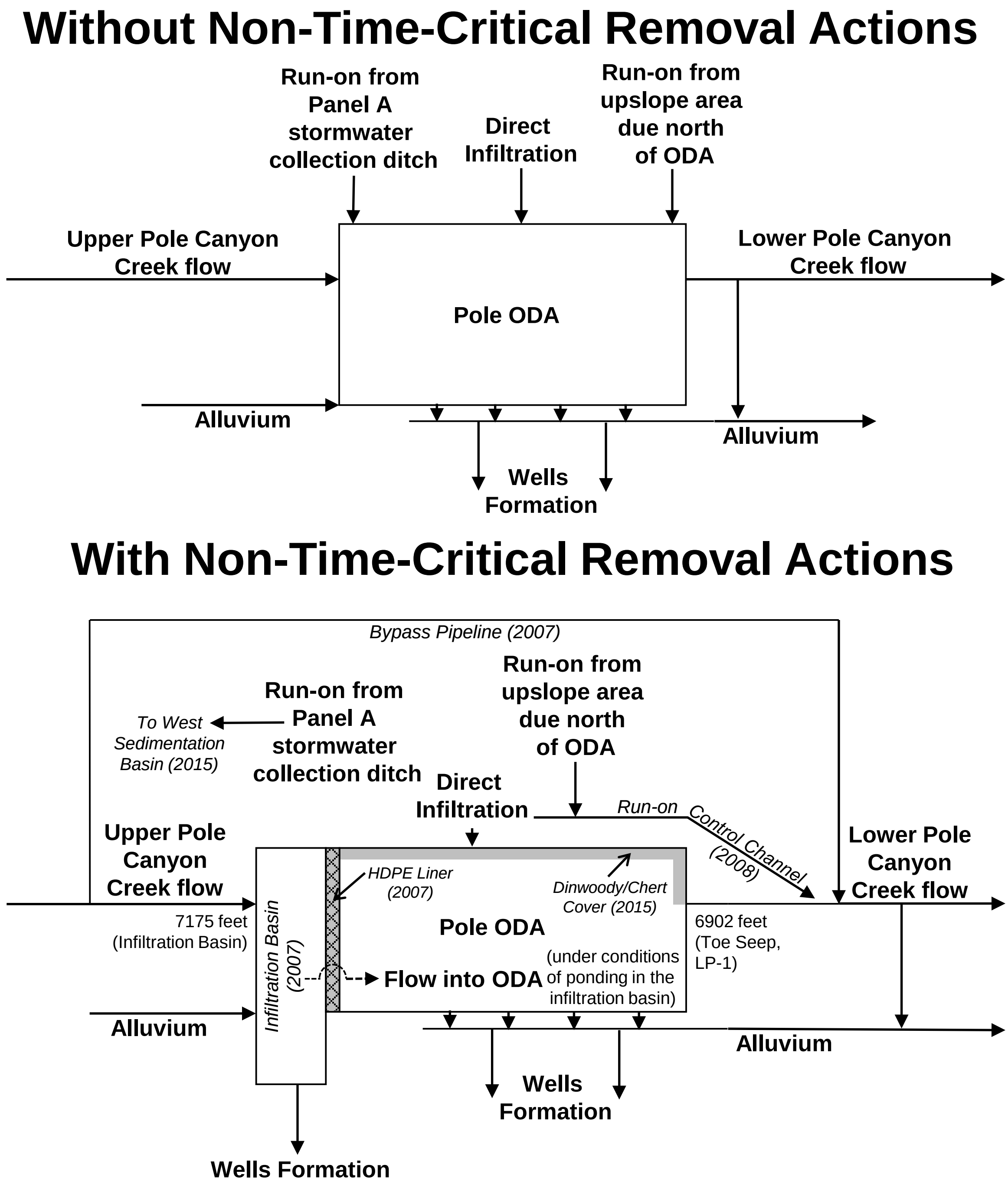

Notes:

1. The "Without Non-Time-Critical Removal Actions" model represents the model inputs/outputs before the Removal Actions were constructed or if the Removal Actions had not been constructed (i.e., the "no action" scenario).
2. The "With Non-Time-Critical Removal Actions" model represents the model inputs/outputs after the Removal Actions were constructed (i.e., the "as-built" scenario).
3. The Non-Time-Critical Removal Action components are in italics with the year of construction in parentheses.
4. There is an impermeable barrier between the infiltration basin and the Pole Canyon ODA, which greatly limits surface or alluvial water in the upper Pole Canyon Creek drainage from entering the ODA.

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SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE 4-1

WATER BALANCE CONCEPTUAL MODEL

DATE: JULY 2019

BY: LJM | FOR: ACK

FORMATION ENVIRONMENTAL

APPENDIX A

Inspection Forms and Photographs

Informal Pipeline Inlet Inspection

Pole Canyon 2006 NTCRA

(April 17, 2018)

Pipeline Inlet Structure (UP-PD) – low flow along upper Pole Canyon Creek with creek water flowing beneath the inlet structure. Minimal flow entering the pipeline; April 17, 2018.

Pipeline Inlet Structure (UP-PD) – flow along upper Pole Canyon Creek is flowing beneath the inlet structure and eventually into the infiltration basin; April 17, 2018.

Spring Inspection

Pole Canyon 2006 NTCRA

(April 30, 2018)

Inspection Record

Pole Canyon Removal Action – Pipeline, Infiltration Basin, Run-on Control Channel

Date, Time, Weather Conditions: 4-30-18 Personnel: EZH

Pipeline, Access, Vents	Condition	Photo No.	Comments Actions Needed or Taken
Pipeline			
General condition	Good		
Connection to inlet structure	Good		
Saturated zones	No		
Erosion over pipe	No		
Alignment settlement or ponding	No		
Interior inspection?	NO		
Vegetation growth	Good		
Attach documentation if pressure testing is needed			
Access Points and Vents			
General condition	Good		
Vent/access (Sta. 4+50)	Good		
Concrete manhole (Sta. 68+15)	Good		
Vent/access (Sta. 13+00)	Good		
Vent screens	Good/Clear		
Buried access markers (at approx. Sta. 23+00, 32+60, 38+50, 48+50)	—		

Summary of Conditions:

Bypass Pipeline Inlet Structure, Gates, Weir	Condition	Photo No.	Comments Actions Needed or Taken
Inlet System			
General condition	Slight Seeping		Water Seeping Before Grizzly Needs Patching
Erosion and riprap	Good		
Stability	Good		
Concrete condition	Good		
Handrail, safety grate	Good		
Inlet grizzly	A little moss		
Floor grating	Good		
Sediment/debris	Flushed		
Gates and Valves (see manufacturer's O&M info for gates and valves)			
Sluice gate (30")	Good		
Sediment sluice gate (24")	Good		
Drain (blind flange)	Good		
Weir and Monitoring Setup			
General condition	Good		
Level check for weir	Good		
Condition of steel	Good		
Monitoring setup condition	Good		
Staff gage	Good		
Datalogger condition/operation	Good		

Summary of Conditions:

 Revised August 2013

Inspection Record

Pole Canyon Removal Action – Pipeline, Infiltration Basin, Run-on Control Channel

Date, Time, Weather Conditions: 4-30-18 Personnel: FZH

Infiltration Basin, Spillway, Sedimentation Basin	Condition	Photo No.	Comments Actions Needed or Taken
Sedimentation Basin			
General condition	Good		
Erosion	Good		
Riprap	Good		
Sedimentation in basin	Minimal		
Vegetation adjacent/within basin	Filling in		
Spillway into Infiltration Basin			
General condition	Good		
Erosion at edges	None New		
Riprap stability	Good		
Infiltration Basin			
General condition	Good		
Erosion at edges	Little		
Stability of rock cover	Good		
Fine sediment in basin	No		
Sinkholes in basin	No		
Vegetation coverage	Good		
Seepage (visible)	No		
Sloughing on sides	No		
Other	—		

Summary of Conditions:

Pole Canyon Run-On Control Channel	Condition	Photo No.	Comments Actions Needed or Taken
Reaches 1 and 2 – Channel			
General condition, TRM condition	Good		
Erosion/sedimentation	No		
Vegetation growth	Good		
Side-hill inflows	No		
Ponding/settlement	No		
Reaches 1 and 2 – Embankments			
Upstream separation berm, crest	Good		
Side slopes – vegetation	Good		
Reach 3 – Channel			
General condition, TRM condition	Good		
Sedimentation/debris	No		
Vegetation growth	Good		
Ponding/settlement	No		
Reach 3 – Cut Slopes			
Stability	Good		
Erosion	Good		
Vegetation growth	Good		

Inspection Record

Pole Canyon Removal Action – Pipeline, Infiltration Basin, Run-on Control Channel

Date, Time, Weather Conditions: 4-30-18 Personnel: EZH

Reach 4 – Steep Chute – Channel			
General condition	Good		
Upstream cutoff wall	Good		
ACB unit condition/stability	Good		
Erosion	Minimal		
Soil infill	Minimal		
Vegetation growth	Good		
Reach 4 – Steep Chute – Embankments			
Crest, side slopes	Good		
Vegetation growth	Good		
Outfall and Dissipation Basin			
General condition	Good		
Concrete cutoff wall	Good		
Riprap/grouted riprap stability	Good		
Sedimentation, debris	Little		
Embankment stability	Good		
Erosion	Minimal		
Sedimentation Basin and Discharge to Channel			
General condition	Good		
Sedimentation, debris	Minimal		
Erosion	No		
End rock zone	Good		
Downstream channel	Good		

Summary of Conditions:

Pipeline Dissipation Structure, Weir	Condition	Photo No.	Comments Actions Needed or Taken
Outlet/Energy Dissipation Structure			
General condition	Good		
Erosion	No		
Sediment in invert	No		
Concrete condition	Good		
Riprap at outlet	Good		
Pipe connection	Good		
Vegetation around structure	Good		
Discharge Weir			
General condition	Good		
Level/position check	No		
Condition of steel	Good Bowed Outward?		
Staff gage	Good		
Datalogger condition/operation	Good		

Summary of Conditions:

Note: Photographs from the Spring 2018 Inspection (April 30, 2018) of the 2006 NTCRA are unavailable. Photographs from the May 2018 Semi-Annual Monitoring Event are provided.

Pipeline Inlet Structure (UP-PD) – pipeline inlet structure with riprap lined channel and grizzly screen (looking downstream). At higher water, flow is again entering pipeline; May 14, 2018.

Pipeline Inlet Structure (UP-PD) – staff gauge and weir plate; May 14, 2018.

Pipeline Outlet Structure (LP-PD) –weir, dissipation structure, and station telemetry; May 18, 2018.

Pipeline Outlet Structure (LP-PD) –weir and staff plate; May 18, 2018.

Pipeline Inlet Repair

Pole Canyon 2006 NTCA

(July 12, 2018)

Pipeline Inlet Structure (UP-PD) – small piping failure is allowing some surface water to flow beneath the pipeline inlet structure; July 12, 2018.

Pipeline Inlet Structure (UP-PD) – the hole beneath concrete inlet structure was filled with approximately 100 pounds of bentonite; July 12, 2018.

Pipeline Inlet Structure (UP-PD) – the bentonite plug was covered with rock for armoring; July 12, 2018.

Fall Inspection

Pole Canyon 2006 NTCRA

(October 22, 2018)

Inspection Record

Pole Canyon Removal Action – Pipeline, Infiltration Basin, Run-on Control Channel

Date, Time, Weather Conditions: 10-22-18 Sunny Personnel: EZH LJM

Pipeline, Access, Vents	Condition	Photo No.	Comments Actions Needed or Taken
Pipeline			
General condition	Okay		
Connection to inlet structure	Good		
Saturated zones	No		
Erosion over pipe	No		
Alignment settlement or ponding	No		
Interior inspection?	No		
Vegetation growth	Acceptable		
Attach documentation if pressure testing is needed			
Access Points and Vents			
General condition	Good		
Vent/access (Sta. 4+50)	Good		
Concrete manhole (Sta. 68+15)	Good		
Vent/access (Sta. 13+00)	Good		
Vent screens	Clear		
Buried access markers (at approx. Sta. 23+00, 32+60, 38+50, 48+50)	Okay		

Summary of Conditions:

Bypass Pipeline Inlet Structure, Gates, Weir	Condition	Photo No.	Comments Actions Needed or Taken
Inlet System			
General condition	Good		Added Bentonte to rip rap/Grizzly intersection to limit infiltration Summer 2018
Erosion and riprap	Good		
Stability	Good		
Concrete condition	Good		
Handrail, safety grate	Good		
Inlet grizzly	Clear		
Floor grating	Good		
Sediment/debris	Good		
Gates and Valves (see manufacturer's O&M info for gates and valves)			
Sluice gate (30")	Good		
Sediment sluice gate (24")	Good		
Drain (blind flange)	Good		
Weir and Monitoring Setup			
General condition	Good		
Level check for weir	Good		
Condition of steel	Good		
Monitoring setup condition	Good		
Staff gage	Clear		
Datalogger condition/operation	Good		

Summary of Conditions:

Inspection Record

Pole Canyon Removal Action – Pipeline, Infiltration Basin, Run-on Control Channel

Date, Time, Weather Conditions: 11-22-18 Personnel: EZH LJM

Infiltration Basin, Spillway, Sedimentation Basin	Condition	Photo No.	Comments Actions Needed or Taken
Sedimentation Basin			
General condition	Good		
Erosion	Good		
Riprap	Good		
Sedimentation in basin	Some Showing Above Water		
Vegetation adjacent/within basin	Good		
Spillway into Infiltration Basin			
General condition	Good		
Erosion at edges	Good		
Riprap stability	Good		
Infiltration Basin			
General condition	Good		
Erosion at edges	Good		
Stability of rock cover	Good		
Fine sediment in basin	Some		
Sinkholes in basin	No		
Vegetation coverage	Good		
Seepage (visible)	Good		
Sloughing on sides	Good		
Other	—		

Summary of Conditions:

Pole Canyon Run-On Control Channel	Condition	Photo No.	Comments Actions Needed or Taken
Reaches 1 and 2 – Channel			
General condition, TRM condition	Good		
Erosion/sedimentation	Good		
Vegetation growth	Acceptable		
Side-hill inflows	Minimal		
Ponding/settlement	No		
Reaches 1 and 2 – Embankments			
Upstream separation berm, crest	No		
Side slopes – vegetation	Acceptable		
Reach 3 – Channel			
General condition, TRM condition	Good		
Sedimentation/debris	Little		
Vegetation growth	Acceptable		
Ponding/settlement	No		
Reach 3 – Cut Slopes			
Stability	Good		
Erosion	Little		
Vegetation growth	Acceptable		

Inspection Record

Pole Canyon Removal Action – Pipeline, Infiltration Basin, Run-on Control Channel

Date, Time, Weather Conditions: 10-22-18 Sunny Personnel: EZH LJM

Reach 4 – Steep Chute – Channel			
General condition	Good		
Upstream cutoff wall	Good		
ACB unit condition/stability	Good		
Erosion	Little		
Soil infill	Little		
Vegetation growth	Acceptable		
Reach 4 – Steep Chute – Embankments			
Crest, side slopes	Good		
Vegetation growth	Accepable		
Outfall and Dissipation Basin			
General condition	Good		
Concrete cutoff wall	Good		
Riprap/grouted riprap stability	Good		
Sedimentation, debris	Little		
Embankment stability	Good		
Erosion	Minimal		
Sedimentation Basin and Discharge to Channel			
General condition	Good		
Sedimentation, debris	Little		
Erosion	Little		
End rock zone	Good		
Downstream channel	Good		

Summary of Conditions:

Pipeline Dissipation Structure, Weir	Condition	Photo No.	Comments Actions Needed or Taken
Outlet/Energy Dissipation Structure			
General condition	Good		
Erosion	No		
Sediment in invert	Little		
Concrete condition	Good		
Riprap at outlet	Good		
Pipe connection	Good		
Vegetation around structure	Acceptable		
Discharge Weir			
General condition	Good		
Level/position check	Good		
Condition of steel	Good		
Staff gage	Good		
Datalogger condition/operation	Good		

Summary of Conditions:

Pipeline Inlet Structure (UP-PD) – riprap line structure upstream of pipeline inlet; October 22, 2018.

Pipeline Inlet Structure (UP-PD) – riprap lined channel and grizzly grate; October 22, 2018.

Pipeline Inlet Structure (UP-PD) – staff plate and weir; October 22, 2018.

Pipeline Inlet Structure (UP-PD) – inlet structure concrete condition and sediment discharge port; October 22, 2018.

Pipeline Inlet Structure (UP-PD) – station telemetry and sediment sluice gate hand wheel; October 22, 2018.

Bypass Pipeline – vent, upstream of infiltration basin and haul road; October 22, 2018.

Bypass Pipeline – pipeline alignment upstream of haul road and infiltration basin; October 22, 2018.

Bypass Pipeline – pipeline alignment downstream of infiltration basin and upstream of haul road; October 22, 2018.

Infiltration basin (UP-IN) – flume (looking downstream); October 22, 2018.

West Sedimentation Basin – sedimentation basin upstream of infiltration basin (looking east towards Pole Canyon ODA); October 22, 2018.

Infiltration Basin – base area and rock protection (looking east towards Pole Canyon ODA); October 22, 2018.

Run-on Control Channel – upper section east of the haul road (looking east); October 22, 2018.

Run-on Control Channel – upper section east of haul road (looking west); October 22, 2018.

Run-on Control Channel– middle section (looking east), October 22, 2018.

Run-on Control Channel – middle section (looking west); October 22, 2018.

Run-on Control Channel – lower section (looking west) October 22, 2018.

Run-on Control Channel – lower section (looking east) October 22, 2018.

Run-on Control Channel – lower section and sediment basin (looking west); October 22, 2018.

Pipeline Outlet Structure (LP-PD) – telemetry system and transducer; October 22, 2018.

Pipeline Outlet (LP-PD) – staff plate and V-notch weir (looking downstream); October 22, 2018.

Pipeline Outlet Structure (LP-PD) – V-notch weir and dissipation structure (looking upstream); October 22, 2018.

Pipeline Outlet Structure (LP-PD) – V-notch weir, dissipation structure, and telemetry system (looking upstream).

Spring Inspection

Pole Canyon 2013 NTCRA

(June 6, 2018)

Inspection Form 1
NTCRA Cover System and Access Roads

DATE/TIME: Wednesday, June 6, 2018 9:30-1:30	WEATHER CONDITIONS/TEMPERATURE:
PERSONNEL: Jeff Hamilton, Ron Quinn, Andrew Herrera, Art Burbank	Sunny, Cool to warm

Location	Condition	Photo No.	Comments Actions Needed or Taken
WEST-SIDE COVER SYSTEM			
Upper West-Side			
General Condition	Good		
Erosion	Small localized rills	1, 2	Need to seed Rills and Wattles and attempt to reduce water flowing onto wattles to the east
Vegetative Growth	OK		
Wattle Conditon	OK		
Rock Stability Buttresses	Good		
Property / Livestock Fencing	Good		
Other			
Central Bench Area			
General Condition	Good		
Erosion/Sedimentation	None		
Gravel Surfacing	Good		
Culvert to West EDS	Good		
Rock Buttress Below	Good		
Property / Livestock Fencing	Good		
Other			
Lower-West Side			
Vegetative Growth	Good		
Watttle Condition	Some Issues	3	Need to Seed Wattles
Pooling at Base	None		
Silt Fence	Good		
Runoff to Infil. Basin	Good		
Property / Livestock Fencing	Good		
Other			
South-Central Area			
General Condition	Some slumping	1	Small localized slope slump that was seeded last year. Need to revisit in Fall to see how vegatation looks.
Vegetative Growth	slow coming in		
Wattle Conditon	Good		
Erosion	Good		
Access from Haul Road	Good		
Silt Fence	None		
Other			

EAST-SIDE COVER SYSTEM			
Top East Area			
General Condition	Good		
Pooling	Minor		
East Runoff Berm	Good		
Vegetative Growth (slopes and ditches)	Coming In	12	Reseeded and fertilized in spring
Erosion	Minor rilling		
24" Culvert at Access Rd.	Good		
Property / Livestock Fencing	Good		
Other			
Blast Compound Area			
General Condition	Good		
Erosion	None observed		
Access from Haul Road	Good		
Security Fencing	Good		
Other			

Inspection Form 1
NTCRA Cover System and Access Roads

Location	Condition	Photo No.	**Comments** **Actions Needed or Taken**
EAST-SIDE COVER SYSTEM (continued)			
SW Side Slope			
Stability	Good		
Erosion	None observed		
Wattle Conditions	Good		
Vegetative Growth	Good		
Other			
South East-Side Slope			
General condition	Good		
Wattle Conditions	Good		
Access Rd. from South	Good		
Erosion	some rilling	5	Seed Wattles
Vegetative Growth	OK		
Slope Stability	Good		
Other			
South East Seep Zone			
General Conditon	Good		
Erosion	minor		
Drainage of Seeps	None observed		
Wattle Conditions	Good		
Vegetative Growth	Good		
Area Stability	Good		
Access Road	Good		
Property / Livestock Fencing	Good		
Other			
Upper East-Side Slope			
General Condition	Good		
Erosion	Some rilling	6	Need to observe vegatation in Fall on Slope Repair
Vegetative Growth	Good		
Wattle Condition	Good	7	Need to add more Vertical Wattles, seed and fertilize
East-Face Runoff Ditch	Good		
36" CMP Culvert & Road	Good		
Runoff Area to East EDS	Good		
Other			
Middle East-Side Slope			
General Condition	Good		
Erosion	Minor to moderate rilling	8	Rilling has developed on cover slope approx 50 feet north of chute to EDS.
Vegetative Growth	Good		
Wattle Condition	Good		
Lower East Runoff Ditch	Good		
Access Road	Good		
Other	Raod Repair	9	Graded access road due to erosion
Lower East-Side Slope			
General Condition	Good		
Erosion	Good		
Vegetative Growth	ok		
Wattle Condition	Good		
Large Rock Toe Zone	Good		
Access Road	Good		
Silt Fence	Good		
Property / Livestock Fencing	Good		
Other			

Inspection Form 2
NTCRA West-Side Drainage Control Features

DATE/TIME: Wednesday, June 6, 2018 9:30-1:30	**WEATHER CONDITIONS/TEMPERATURE:**
PERSONNEL: Jeff Hamilton, Ron Quinn, Andrew Herrera, Art Burbank	**Sunny, Cool to warm**

Location	Condition	Photo No.	Comments Actions Needed or Taken
PANEL A RUNOFF, INLET TO HAUL-ROAD CULVERT, CULVERT, AND UPPER WEST-SIDE RUNOFF			
Panel A Runoff and Inlet to 42-Inch Culvert			
General Condition	OK		
Erosion/Sedimentation	Good		
Riprap in Channel	Good		
Stability of Hillside	OK		
Concrete Inlet Structure	Good; clear of sediment		
Trash Rack Condition	Good		
Debris at Inlet	Clear		
Other			
42-Inch CMP Culvert			
General CMP Condition	Good		
Sedimentation in CMP	Good		
Stability of Cover	Good		
Outlet Grouted Riprap	Good		
Other			
Runoff to West Energy Dissipation Structure (EDS)			
General Condition	Good		
Erosion/Sedimentation	some		
Riprap in Channel	Good		
Embankment Stability	Good		
Ditch Curve Section	Good		
Access along Channel	Good		
Other			

WEST ENERGY DISSIPATION STRUCTURE AND LOWER WEST-SIDE RUNOFF			
West Energy Dissipation Structure			
Concrete Cutoff Wall	Good		
Grouted Riprap	Good		
Sedimentation	Some	4	Need to remove sediment
Ditch to Culvert	Good		
Other			
48-Inch CMP Culvert			
General CMP Condition	Good		
Erosion/Sedimentation	None observed		
Inlet/Outlet	Good		
Cover Fill	Good		
Other			
Lower Runoff Ditch			
General Conditon	Good		
Stability (Access Road)	Good		
Riprap Condition	Good		
Erosion/Sedimentation	None observed		
Other			
Outfall to West Sedimentation Basin			
General Condition	Good		
Concrete Cutoff Wall	Good		
Grouted Riprap	Good		
Erosion	None observed		
Other			

Inspection Form 2
NTCRA West-Side Drainage Control Features

Location	Condition	Photo No.	Comments Actions Needed or Taken
DISCHARGE FROM NW BASIN TO INFILTRATION BASIN			
General Condition	Good		
TRM Lining in Ditch	Good		
Erosion	None observed		
Concrete Cutoff Wall	Good		
Grouted Riprap Chute	Good		
Outfall into Infil. Basin	Good		
Vegetation	Coming in		

SOUTH RUN-ON DITCHES			
General Condition	Good		
Erosion/Sedimentation	None observed		
Vegetative Growth	Good		
TRM Condition	Good		
Silt Fencing	Good		
Other			

SOUTH WEST-SIDE RUNOFF SYSTEM			
South Runoff Ditch to West-Side South Sedimentation Basin			
General Condition	Good		
Erosion/Sedimentation	Minor		
Vegetative Growth	Good		
TRM Condition	Good		
Rock Riprap Stability	Good		
Silt Fencing	-		
Other			
Discharge Ditch from West-Side South Basin			
General Condition	Good		
Erosion/Sedimentation	Minor		
Riprpap Conditon	Good		
Grouted Riprap Outfall	Good		
Other			
36-Inch CMP South Haul Road Culvert			
General CMP Condition	Good		
Cover Fill	Good		
Inlet/Outlet	Good		
Riprap at Outlet	Good		
Other			

Inspection Form 3
NTCRA East-Side Drainage Control Features

DATE/TIME: Wednesday, June 6, 2018 9:30-1:30	WEATHER CONDITIONS/TEMPERATURE:
PERSONNEL: Jeff Hamilton, Ron Quinn, Andrew Herrera, Art Burbank	Sunny, Cool to warm

Location	Condition	Photo No.	Comments Actions Needed or Taken
EAST-SIDE HAUL ROAD RUNOFF SYSTEM			
Upstream Area			
General Condition	Good		
Erosion/Sedimentation	None observed		
TRM Condition	Good		
Vegetation	Good		
Drainage to 24" Culvert	Good		
24-Inch CMP Condition	Good		
Discharge from Culvert	Good		
Other			
Middle Area			
General Condition	Good		
Erosion/Sedimentation	Good		
TRM Conditon	Good		
Vegetation	Good		
Riprap below Downdrain	Good		
Other			
Downdrain from Top			
General Condition	Good		
Cutoff Wall	Good		
Erosion/Sedimentation	Good		
Riprap Condition	Good		
Other			
Lower Area			
General Condition	Good		
Riprap Condition	Good		
Concrete Cutoff Wall	Good		
Erosion/Sedimentation	None observed		
Cutoff Wall	Good		
Grouted Riprap Chute	Good		
Lower Cutoff Wall	Good		
Concrete Apron Outfall	Good		
Other			

DISCHARGE CHANNEL FROM SOUTH-CENTRAL SEDIMENTATION BASIN			
General Condition	Good		
Erosion/Sedimentation	None observed		
TRM Condition	Good		
Vegetative Growth	Good		
Cutoff Wall	Good		
Side Slopes	Good		
Vegetation	Good		
Grouted Riprap Chute	Good		
Other			

Inspection Form 3
NTCRA East-Side Drainage Control Features

Location	Condition	Photo No.	Comments Actions Needed or Taken
EAST ENERGY DISSIPATION STRUCTURE AND DISCHARGE TO SADDLE BASIN			
East Energy Dissipation Structure			
Concrete Cutoff Wall	Good		
Grouted Riprap	Good		
Sedimentation	Moderate accumulation	10	Needs to be cleared of sediment as part of regular O&M
Discharge Control	Good		
Other			
Ditch to Saddle Basin			
General Condition	Good		
TRM Condition	Good		
Erosion/Sedimentation	Minor		
Vegetation	Good		
Other			

SOUTHEAST RUNOFF DITCH			
General Condition	Good		
Riprap Condition	Good		
Vegetative Growth	Good		
TRM Condition	Good		
Hillside Inflows	Good		
Erosion/Sedimentation	None observed		
Vegetative Growth	Good		
Other			

DISCHARGE DITCH FROM EAST SEDIMENTATION BASIN			
General Condition	Good	11	
TRM Condition	Good		
Erosion/Sedimentation	None observed		
Vegetation	Good		
Riprap Condition	Good		
Other	Silt Fence		remove fence in stream

Inspection Form 4
NTCRA West-Side Sedimentation/Detention Basins - Pipe Outlets and Spillways

DATE/TIME: Wednesday, June 6, 2018 9:30-1:30	**WEATHER CONDITIONS/TEMPERATURE:**
PERSONNEL: Jeff Hamilton, Ron Quinn, Andrew Herrera, Art Burbank	**Sunny, Cool to warm**

Location	Condition	Photo No.	Comments Actions Needed or Taken
WEST-SIDE SOUTH SEDIMENTATION BASIN			
General condition	Good		
Erosion	None observed		
Embankments	Good		
Riprap Inflow	Good		
Internal Rock Berm	Good		
Dinwoody Liner	Good		
Water Depth	None observed		
Sediment Depth	Minor		
Spillway Control	Good		
Spillway Discharge	Good		
Pipe Support & Trashrack	Good		
Pipe Condition	Good		
Pipe Clogging	None observed		
Pipe Discharge	Good		
Vegetation	Coming in		
Other			

WEST SEDIMENTATION BASIN			
General condition	Good		
Erosion	OK		See below
Inflow Rock Diss.	Good		
Water Depth	Estimated at 24 inches		
Sedimentation	-		
Rock Overflow	Good		
Vegetation	Coming in		
Access Road to West Sedimentation Pond		14, 15	Repaired Road and built water bars on road

NORTHWEST SEDIMENTATION/DETENTION BASIN			
General condition	Good		
Erosion At Edges	None observed		
Embankments	Good		
Inflow Riprap	Good		
Internal Berm	Good		
Grouted Riprap	Good		
Dinwoody Liner	Good		
Water Depth	None observed		
Sediment Depth	minimal		
Spillway Control	Good		
Spillway Discharge	Good		
Pipe Support & Trashrack	Good		
Pipe Condition	Good		
Pipe Clogging	None observed		
Pipe Discharge	Good		
Vegetation	Good		
Other			

Form Date: February 2016

Inspection Form 5
NTCRA East-Side Sedimentation/infiltration Basins - Pipe Outlets and Spillways

DATE/TIME: Wednesday, June 6, 2018 9:30-1:30	WEATHER CONDITIONS/TEMPERATURE:
PERSONNEL: Jeff Hamilton, Ron Quinn, Andrew Herrera, Art Burbank	Sunny, Cool to warm

Location	Condition	Photo No.	Comments Actions Needed or Taken
SOUTH-CENTRAL SEDIMENTATION BASIN			
General condition	Good		
Erosion	None observed		
Embankments	Good		
Riprap Inflow	Good		
Internal Rock Berm	Good		
Dinwoody Liner	Good		
Water Depth	Minor on one end		
Sediment Depth	Minor		
Spillway Control	Good		
Spillway Discharge	Good		
Pipe Support & Trashrack	Good		
Pipe Condition	Good		
Pipe Clogging	None		
Pipe Discharge	Good		
Vegetation	Good		
Other			

SADDLE SEDIMENTATION/INFILTRATION BASIN			
General condition	Good		
Erosion	None observed		
Embankments	Good		
Riprap Inflow	Good		
Internal Rock Berm	Good		
Dinwoody (1st Cell)	Good		
Water Depth	1.5'		
Sediment Depth (1st Cell)	Not measured		
Infiltration (2nd Cell)	1.5'		
Spillway Control	Good		
Spillway Discharge	Good		
Vegetation	Coming in		
Other			

EAST SEDIMENTATION BASIN			
General condition	Good		
Erosion At Edges	None observed		
Embankments	Good		
Inflow Riprap	Good		
Internal Berm	Good		
Dinwoody Liner	Good		
Water Depth	None observed		
Sediment Depth	Minor amount		
Spillway Control	Good		
Spillway Discharge	Good		
Vegetation	Good		
Other			

Inspection Form 6
Dinwoody Borrow Area and Sedimentation Basins

DATE/TIME: Wednesday, June 6, 2018 9:30-1:30	**WEATHER CONDITIONS/TEMPERATURE:**
PERSONNEL: Jeff Hamilton, Ron Quinn, Andrew Herrera, Art Burbank	**Sunny, Cool to warm**

Location	Condition	Photo No.	Comments Actions Needed or Taken
NORTH BORROW AREA			
Run-On Ditch To North			
General Condition	Good		
Erosion	None observed		
Sedimentation/Debris	None observed		
Vegetative Growth	Good		
TRM Condition	Good		
Rock Discharge Apron	Good		
Other			
North Closure Area			
General Condition	Fair to Good		
Erosion/Sedimentation	None observed		
Wattle Conditions	Some Work Needed		
Vegetative Growth	Thin		
Runoff Swale Condition	Good		
Slope Erosion Protection	Good		
Fence	Good		
North Access Road			
General Condition	Good		
Erosion/Sedimentation	None observed		
Other			

SOUTH BORROW AREA			
Run-on Ditch to South			
General Condition	Good		
Erosion	None observed		
Sedimentation/Debris	None observed		
Vegetative growth (slopes and ditches)	Good		
TRM Condition	Good		
Rock Discharge Apron	Good		
Other			
South Closure Area			
General Condition	Good		
Erosion/Sedimentation	None observed		
Wattle Conditions	Good		
Vegetative Growth	Good to Coming in		
Runoff Swale Condition	Good		
Slope Erosion Protection	Good		
Fence			
Access Road to South			
General Condition	Pretty Good		
Erosion/Sedimentation	Some Minor		
Other			

Inspection Form 6
Dinwoody Borrow Area and Sedimentation Basins

Location	Condition	Photo No.	Comments Actions Needed or Taken
NORTH SEDIMENTATION BASIN			
General condition	Good		
Erosion	None observed		
Sedimentation in Basin	Good		
Embankment	Good		
Rock Inflow Protection	Good		
Water in Basin	Approx 3 feet deep		
Vegetation	Minimal		
Riprap Spillway	Good		
Other			

SOUTH SEDIMENTATION BASIN			
General condition	Good		
Erosion	None observed		
Sedimentation in Basin	Good		
Embankment	Good		
Rock Inflow Protection	Good		
Water in Basin	1 foot freeboard		
Vegetation	Coming in Sparse		
Riprap Spillway	Good		
Other			

<u>POLE CANYON COVER NTCRA INSPECTION PHOTO LOG – June 6, 2018</u>

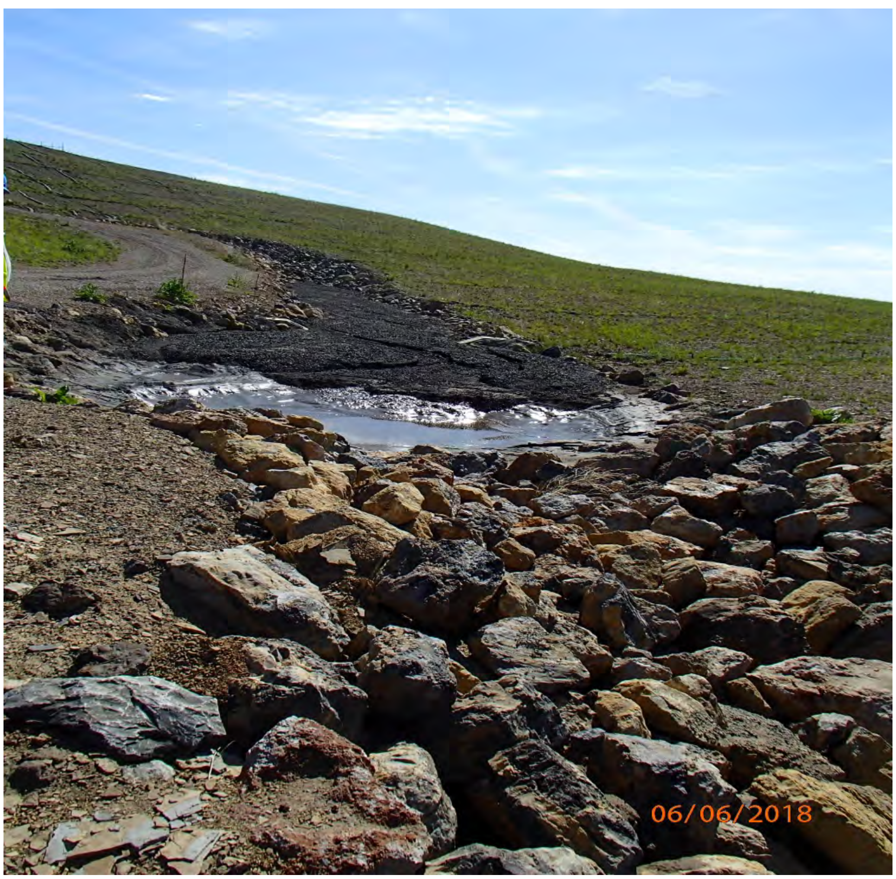
WEST-SIDE COVER SYSTEM

Upper West Side – Rilling and Slope Slump

Upper West Side Water flowing onto Wattles– Pic 02

Rilling Lower Westside Pic 03

West Energy Dissipation Structure Sediment in Basin Pic 04



EAST-SIDE COVER SYSTEM

Wattles on South East Side Pic 05

Upper East Side Slope Repair Pic 06

Upper East Side Slope Pic 07

Upper East Side Rills Pic 08

Road Repair Middle East Side Pic 09

East Energy Dissipation Feature Pic 10

East Sedimentation Basin Pic 11

Upper East Side Topsoil and Seeded Pic 12

North West Sediment Basin Road Repair Pic 14

Water Bars Pic 15

Fall Inspection

Pole Canyon 2013 NTRCRA

(November 6, 2018)

**NOTE: Due to the snow cover during the inspection,
it was determined that completion of the PRSC checklist was not needed.**

<u>**POLE CANYON COVER NTCRA INSPECTION PHOTO LOG – Fall 2018**</u>

WEST-SIDE COVER SYSTEM

Upper West Side Rill repair (Pic 01)

Upper West Side Road Repair (Pic 02)

Rilling Lower Westside Rill Repair (Pic 03)

Water Bars on Road (Pic 04)

Cleanout of Sediment Basin (Pic 05 and 06)

EAST-SIDE COVER SYSTEM

Upper East Side Rill Repairs (Pic 07)

Upper East Side Slope showing hydromulch (Pic 08)

Upper East Side Rills Repairs (Pic 09)

Upper East Side additional wattles and seeding (Pic 10)

East Road Repairs (Pic 11)

Repaired Ponding Near Blast Compound (Pic 12)

APPENDIX B

Analysis of Continuous Flow Measurements

APPENDIX B

ANALYSIS OF CONTINUOUS FLOW MEASUREMENTS

This appendix presents the methodologies for collection of continuous flow data in the area of the Pole Canyon overburden disposal area (ODA). Two flumes and two weirs have been permanently installed to continuously collect flow data in this area (Figure B-1). The flumes are located upstream of the infiltration basin (station UP-IN) and immediately downstream from the ODA toe seep (LP-1). The weirs are located at the pipeline inlet (UP-PD) and pipeline outlet (LP-PD).

B.1 Flumes

Flumes were installed upstream from the infiltration basin (station UP-IN) and immediately downstream from the ODA toe (LP-1) in early 2009 (Figure B-1). A 12-inch Parshall flume is installed at station UP-IN that is capable of accurately measuring flow in the range of 0.12 cubic feet per second (cfs) to 16.13 cfs. A 3-inch Parshall flume is installed at station LP-1 that is capable of accurately measuring flow in the range of 0.028 cfs to 1.86 cfs. Both flumes are made of fiberglass and are outfitted with pressure transducers and data loggers to record the water levels in the flumes on 15-minute intervals. The water level within each flume can be converted to flow using empirical equations. The empirical equation used to calculate flow through the flumes is presented in the *Handbook on Weirs and Flumes* (USBR 2001):

$$Q = 4h^{1.522} \quad \text{(12-inch Parshall flume equation)}$$

$$Q = 0.992h^{1.55} \quad \text{(3-inch Parshall flume weir equation)}$$

Where:

Q = discharge (cfs)

h = head on the weir (feet)

Calibration measurements are made at UP-IN and LP-1 during the sampling events to correct for transducer drift and to ensure that the transducers are operating properly.

B.2 Weirs

Permanent weirs were installed in 2009 within the bypass pipeline inlet structure (UP-PD) and outlet structure (LP-PD) to monitor flow entering and exiting the pipeline (see locations on Figure B-1). These weirs were installed to provide flow data to help identify if the pipeline may be leaking. A combination weir (v-notch and rectangular) was installed within the inlet structure while a conventional v-notch weir was installed within the outlet structure. Both weirs are made of stainless steel and are equipped with pressure transducers and data loggers to record the water level behind the weir, which can be converted to flow using calibrated empirical equations.

The empirical equation used to calculate flow through the outlet structure v-notch weir is presented in the *Handbook on Weirs and Flumes* (USBR 2001):

$$Q = 2.49h^{2.48}$$ (90-degree v-notch weir equation)

Where:

Q = discharge (cfs)

h = head on the weir (feet)

There are no standard equations for the type of combination weir at UP-PD. Therefore, during the first full year of weir operation in 2010, the flow measured at the outlet structure was used to better calibrate the weir equation coefficients used in the inlet structure combination weir equation. The corrected combination weir equation for water levels up to 3 inches (0.25 feet; the height of the v-notches in the combination weir) is shown below:

$$Q = 7.8 * 2.47301 * (h + 0.002903)^{2.51}$$ (when h <= 0.25 feet)

Where:

Q = discharge (cfs)

h = head on the weir (feet)

When the head on the inlet structure weir is greater than 3 inches (0.25 feet), the following corrected combination weir equation is used:

$$Q = 0.61198 + 26.64 * (h - 0.25)^{1.345}$$ (when h > 0.25 feet)

Calibration measurements are made at LP-PD and UP-PD during the sampling events to correct for transducer drift and to ensure that the transducers are operating properly.

B.3 Pipeline Control Chart

Control charts are a useful, graphical method of monitoring the performance of equipment and instrumentation. This type of chart can be used to track the performance over time and can give operators a quick and easy way to determine if the equipment is performing as expected. Control charts can also be used as an early indicator to identify if the equipment performance is deviating from an acceptable range before the equipment has completely failed. For the Pole Canyon Creek bypass pipeline, control charts are useful to monitor flow entering and exiting the pipeline over time to determine if a leak could be developing. If the control chart indicates that there may be an emerging leak, then more extensive leak detection methods may be employed.

Comparisons of the flow rates between the inlet structure (UP-PD) and outlet structure (LP-PD) and cumulative flow volume for the water year are shown in Figure B-2. A chart showing the relative difference of annual cumulative volume of flow since flow monitoring was initiated in late 2009 is also shown in Figure B-2.

In order to construct the flow control chart (Figure B-2) for the period of record, the following steps were followed: (1) instantaneous flows were measured at both the inlet and outlet structure weirs on a 15-minute interval; (2) the instantaneous flows were used to calculate daily average flows; (3) the daily average flows were used to calculate daily flow volumes (in acre-feet); and (4) the daily flow volumes were summed over time for both the inlet and the outlet flows. The cumulative difference in flow was then plotted over time on the control chart. If a leak was developing, the control chart would show a negative slope (downward) over time. As shown in Figure B-1, comparisons of cumulative flow volume at the pipeline inlet and outlet show small variations in flow since monitoring was initiated in late 2009. This long-term information confirms the pipeline is operating as designed.

Only a limited amount of data is available to review in the 2018 control chart (Figure B-2). As discussed in the text, surface water in upper Pole Canyon Creek began flowing beneath the pipeline inlet structure (UP-PD) during January. Since the stage in the creek was low, flow was not entering the pipeline. As a result, flow data is not available until early April 2018. As the spring runoff began, stage in upper Pole Canyon Creek rose and water reentered the pipeline; therefore, flow data is available at the pipeline outlet (LP-PD). The transducer at UP-PD became damaged during the winter due to freezing and flow data are not available until the transducer was replaced on May 30. Manual stage readings at the inlet and outlet weirs confirmed that flow at the pipeline inlet and outlet were equal.

Review of the 2018 control chart (Figure B-2) shows positive slopes with no distinct downward trend, and thus no indication of leakage during this period. As shown in Figure B-2, there is primarily an upward trend resulting from small but consistent differences between flows measured at UP-PD and LP-PD. Flows measured at the pipeline outlet (LP-PD) during this period were slightly higher than those measured at the pipeline inlet (UP-PD). This difference may be due to possible instrument drift at UP-PD and/or LP-PD and surging of discharge during high-flow periods. To monitor this, ongoing evaluation of flow monitoring data is underway at these locations with correction to flow measurements possible based on new information.

B.4 Reference

United States Department of the Interior, Bureau of Reclamation (USBR). 2001. Water Measurement Manual. A Water Resources Technical Publication.

FIGURES

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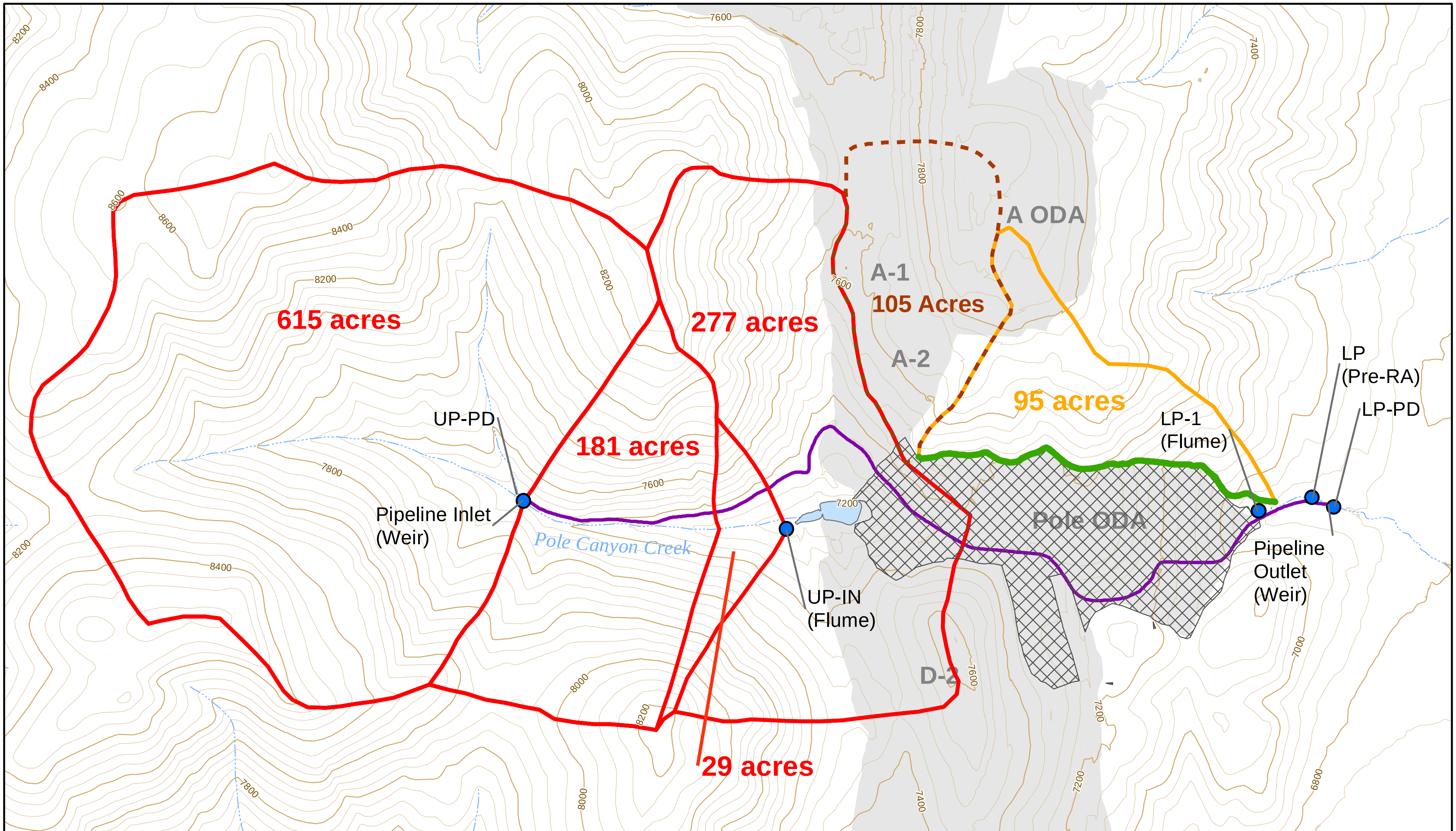

Legend

- Flume and Weir Locations
- Drainage Area for Runoff from Panel A Reclaimed Area
- Pole Canyon ODA 2013 NTCRA Cover Area
- Upper Pole Canyon Creek Watershed
- Run-on Control Channel Watershed
- Bypass Pipeline (2006 NTCRA)
- Run-on Control Channel (2006 NTCRA)
- Sedimentation/Infiltration Basin (2006 NTCRA)
- Mine Disturbance

NTCRA = Non-Time-Critical Removal Action

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE B-1

UPPER POLE CANYON CREEK WATERSHED AND NTCRA COMPONENTS

DATE: JULY 2019
BY: CRL | FOR: ACK

FORMATION ENVIRONMENTAL

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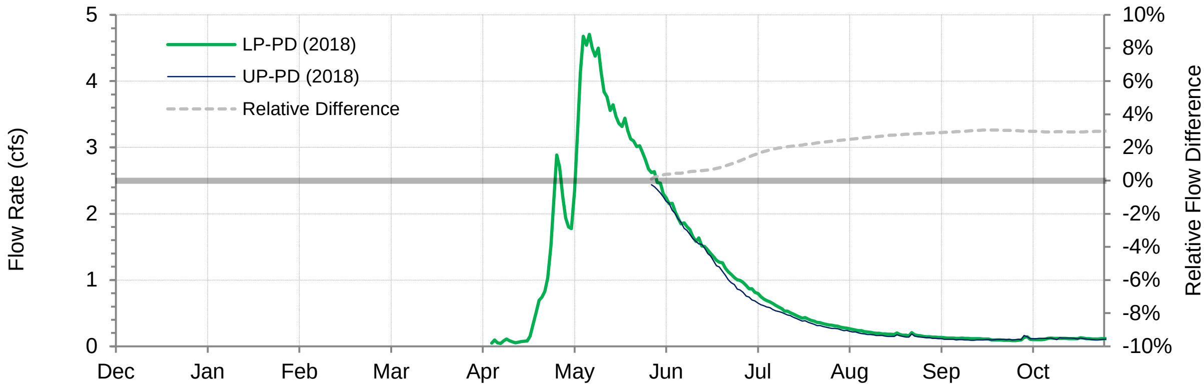
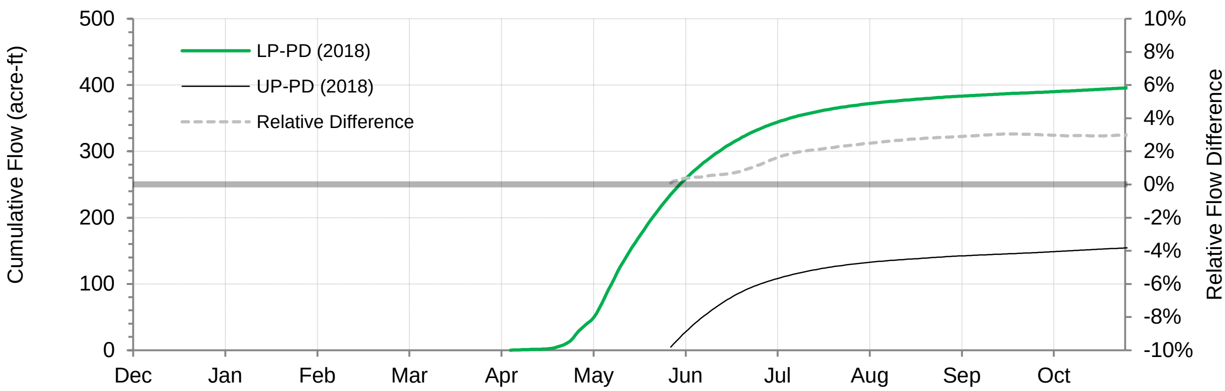
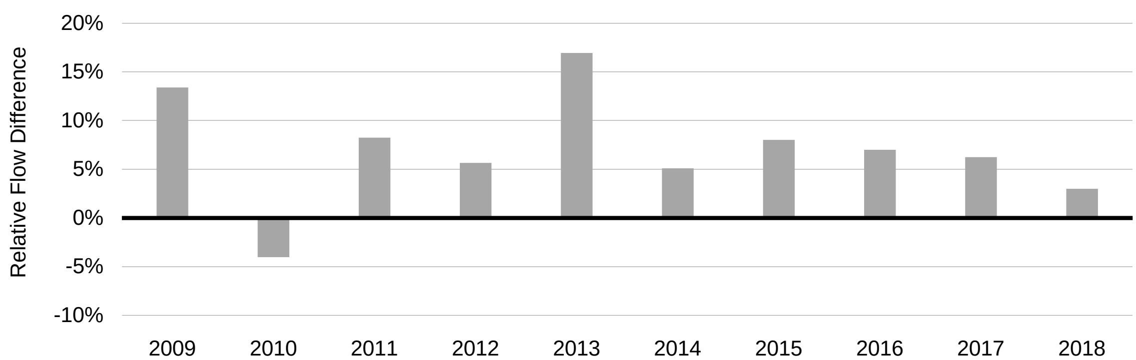






Notes:

1. Relative flow difference is based on total volume discharged over the year, as measured at the LP-PD weir. A positive difference indicates more water was calculated discharging from the pipeline than entering at the inlet.
2. Pipeline flow data is unavailable from December 2017 to April 2018. Streamflow began bypassing the pipeline inlet in December 2017 and flowed to the infiltration basin. As flows increased, streamflow resumed flowing through the pipeline in April 2018. Repairs were made to the inlet in July 2018 by filling a hole beneath the structure with about 100 pounds of granular bentonite.
3. Cumulative flow difference calculated for period when transducers at both LP-PD and UP-PD were operational.

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE B-2

BYPASS PIPELINE INFLOW/OUTFLOW COMPARISON

DATE: JULY 2019

BY: LJM | FOR: ACK

FORMATION ENVIRONMENTAL

APPENDIX C

2004–2018 Flow, Water Quality, Groundwater Level, and Vegetation Monitoring Data (on CD only)

APPENDIX D

Statistical Evaluation of Monitoring Data

APPENDIX D

STATISTICAL EVALUATION OF MONITORING DATA

The Pole Canyon Non-Time-Critical Removal Action Environmental Monitoring Plan Revision No. 5 (EMP Rev 5) (Formation 2018) specifies that selenium concentrations at key monitoring locations will be evaluated using statistical methods. The purpose of the statistical evaluation is to confirm the effectiveness of the 2006 Water Management Non-Time-Critical Removal Action (2006 NTCRA) in reducing selenium transport from the Pole Canyon overburden disposal area (ODA) to surface water and groundwater flow pathways. A second NTCRA, the Pole Canyon Dinwoody/Chert Cover NTCRA (2013 NTCRA), was implemented to address infiltration into the ODA from direct precipitation and snowmelt.

The anticipated effects of the 2006 NTCRA are reductions in transport of selenium from the Pole Canyon ODA to downstream surface water and to downgradient groundwater in both the alluvial aquifer in Sage Valley and in the Wells Formation aquifer. The statistical evaluation of surface water and groundwater monitoring data is intended to confirm when such reductions have taken place.

The statistical evaluation is based on observed selenium concentrations in surface water and groundwater samples collected at key monitoring locations downstream and downgradient of the ODA. Due to the dynamic nature of infiltration conditions in portions of the mine and the resultant potential for variable selenium contributions over time from these dynamic source areas to groundwater and surface water flow systems, decision-making regarding the effectiveness of the Pole Canyon NTCRA relies on data collected at monitoring locations not influenced by selenium from sources other than the Pole Canyon ODA.

Those locations are: (1) alluvial and Wells Formation groundwater monitoring locations that are downgradient of the Pole Canyon ODA but upgradient of potential transport pathways from ongoing source areas, which include alluvial monitoring wells GW-15 and GW-22 (two sample depths) and Wells Formation monitoring well GW-16 and (2) surface water monitoring stations that are downstream of the Pole Canyon ODA but upstream of potential transport pathways from other sources, which include the pre–NTCRA lower Pole Canyon Creek station LP and post–NTCRA station LP-PD, North Fork Sage Creek station NSV-6, and Sage Creek station LSV-1 upstream of the inflow from the Hoopes Spring complex.

The decision rules specified in EMP Rev 5 (Formation 2018) for evaluating the effectiveness of the 2006 NTCRA in reducing selenium transport to surface water or groundwater have the following general form:

- If after implementation of the NTCRA selenium concentrations and mass loads in lower Pole Canyon Creek water either increase or remain the same as pre-NTCRA concentrations and mass loads, then the Removal Action does not reduce surface water transport of selenium from the ODA to lower Pole Canyon Creek or to northern Sage Valley. Alternatively, if the selenium concentrations and mass loads decrease in downstream creek water, then the NTCRA is effective at reducing transport to surface water in lower Pole Canyon and northern Sage Valley.

- If after implementation of the NTCRA selenium concentrations in downgradient groundwater either increase or remain the same compared to pre-NTCRA concentrations, then the NTCRA does not reduce selenium transport from the ODA to groundwater. Alternatively, if the selenium concentrations decrease in downgradient groundwater, then the NTCRA is effective at reducing transport to groundwater.

Note that a finding that the 2006 NTCRA reduces selenium transport from the ODA (i.e., rejection of the null hypothesis) along either surface water or groundwater pathways does not imply that a specific performance standard for the NTCRA has been met. The Administrative Settlement Agreement and Order on Consent/Consent Order (ASAOC) Statement of Work (SOW) for the Pole Canyon NTCRA sets forth specific performance standards for work performed to implement the 2006 NTCRA (refer to Section 2.4 of the 2006 ASAOC SOW; U.S. Department of Agriculture Forest Service [USFS], U.S. Environmental Protection Agency [USEPA], and Idaho Department of Environmental Quality [IDEQ] 2006). A separate ASAOC entered into by the USFS, IDEQ, the Shoshone-Bannock Tribes (Tribes), and Simplot (USFS, IDEQ, and Tribes 2013) sets forth performance standards for work performed to implement the 2013 NTCRA. Neither of the SOW performance standards include specific, quantitative reductions in selenium concentrations or selenium mass loads associated with transport pathways from the Pole Canyon ODA.

If there is no change or an increase in selenium transport from the Pole Canyon ODA following implementation of the 2006 NTCRA, then effectiveness of the NTCRA has not been demonstrated and additional actions may be needed to limit transport of selenium from the Pole Canyon ODA to groundwater and surface water. If selenium transport decreases following implementation of the 2006 NTCRA, then the effectiveness of the NTCRA will be demonstrated, and the need for additional actions will ultimately depend on the magnitude of that decrease relative to final Remedial Action Objectives developed through the ongoing Remedial Investigation/Feasibility Study (RI/FS) process at the Smoky Canyon Mine.

The evaluation of the surface water and groundwater pathways in 2018, as covered in this statistical evaluation, includes effects of both NTCRAs by default, because the effects of the Water Management and Dinwoody/Chert cover system NTCRAs cannot be separated.

D.1 Statistical Evaluation of Monitoring Data

The key monitoring locations for statistical evaluation are GW-15 and GW-22 for alluvial groundwater; GW-16 for Wells Formation groundwater; and LP/LP-PD, NSV-6, and LSV-1 for surface water. Statistical evaluation of pre- and post-NTCRA monitoring data from these locations was performed in general accordance with the procedures described in EMP Rev 5 (Formation 2018). However, comparison of pre- and post-NTCRA data was not possible for GW-22 as the majority of the samples were collected after completion of the 2006 NTCRA; therefore, the statistical analysis for this location focused only on changes in concentration since completion of the 2006 NTCRA.

Data for statistical evaluation were compiled from monitoring records dating from 2000 through 2018. The pre-NTCRA monitoring data were collected from May 2000 through September 2007 (diversion of Pole Canyon Creek was completed in late September 2007; other elements of the NTCRA were not completed until the end of 2008). The post-NTCRA monitoring data were collected from October 2007 through October 2018. Selenium concentrations vary seasonally at many of the key monitoring locations. To address seasonal effects, data from each location were split into two separate groups that represent two general seasons with distinct precipitation, runoff, and surface flow conditions: (1) Fall-Winter (September through March) and (2) Spring-Summer (April through August). In general, the months of September through March are characterized by relatively cool conditions, low potential for storms generating surface runoff, and low surface water flows; these are categorized as fall-winter months. The months of April through August have higher surface water flows associated with spring snowmelt and summer storm events that result in surface runoff, or a combination of both; these are categorized as spring-summer months.

The resultant seasonal data set compiled for each monitoring location is presented in Table D-1. Samples collected at monitoring locations GW-15, LP-PD, LSV-1, and NSV-6 from June 14 and 15, 2011 were collected at a time when the creek bypass pipeline was not functioning as designed; the results associated with these samples are not considered representative of typical post-NTCRA conditions and, therefore, have been excluded from statistical comparison tests.

Whenever sufficient data were available, the statistical tests were performed separately for each seasonal data set from each location. Statistical outlier testing was performed on post-NTCRA data sets large enough for outlier testing (i.e., $n \geq 8$) using the Dixon outlier test at the 99 percent confidence level ($\alpha = 0.01$). The high confidence level was selected to address concerns reflected in the USEPA guidance regarding removal of outlier values from data sets used for statistically-based monitoring programs (USEPA 2009). Unusual, and possibly discrepant, values can occur in a monitoring data set for many reasons, including (1) an actual contaminant release that significantly impacts measurements, (2) accurate/true but extreme background groundwater measurements, (3) inconsistent sampling or analytical chemistry methodology resulting in laboratory contamination or other anomalies; and (4) errors in the transcription of data values or decimal points (USEPA 2009). Outlier values explained by reasons 3 and 4 are inaccurate measurements that should be removed from data sets used in statistical analyses. Although removal of outliers may be appropriate even if no probable error or discrepancy can be firmly identified, current USEPA (2009) guidance cautions that statistical outliers should not be treated as such until a specific reason for inaccuracy (e.g., erroneous result or non-representative measurement) can be determined. Valid reasons for removal of outlier values might include contaminated sampling equipment, laboratory contamination of the sample, errors in transcription of the data values, etc.

The results of the outlier testing are summarized below in Table D-2. Only upper tail outliers were identified. No evidence has been found (inconsistent sampling or analytical laboratory errors, etc.) to warrant the removal of these outliers.

Table D-2. Results of Outlier Testing

Monitoring Location	Sample Date	Selenium Concentration (mg/L)	Decision
GW-16	9/10/2008	1.27	Not Removed
LP-PD	9/12/2015	0.0014	
LP-PD	5/19/2008	0.0409	
LSV-1	9/17/2008	0.0014	
LSV-1	5/20/2013	0.0041	

For each key monitoring location, one of two types of tests was performed: a two-sample comparison test or a test for trend. The criteria for performing either of these tests and the procedures for implementing them are described below. Two-sample comparison tests were performed when a minimum of five independent results were available for both pre-NTCRA and post-NTCRA time periods at the tested location. For all other data sets, a test for trend was applied to evaluate changes in selenium concentrations (or mass loads) over time.

Each seasonal data set was first tested for normality to determine the data distribution type and allow for selection of an appropriate comparison test procedure (parametric vs. non-parametric). The Shapiro-Wilk test for normality was performed at the 95 percent confidence level (α = 0.05).[1] When both the pre-NTCRA and post-NTCRA data sets were normally or lognormally

[1] Refer to USEPA Unified Guidance (USEPA 2009) for specific details regarding the Shapiro-Wilk test for normality, Section 10.5.

distributed, a parametric comparison test (a one-sided t test[2]) could be performed at the 90 percent confidence level ($\alpha = 0.10$). When either the pre-NTCRA or post-NTCRA data set was not normally distributed, a non-parametric comparison test (the Wilcoxon rank-sum test[3]) could be performed at the 90 percent confidence level. For most of the two-sample data sets to be tested, either one or both were not normally distributed. For this reason, the Wilcoxon rank-sum test was used to complete all of the two-sample comparison tests. The results of the normality and comparison tests are reported for each data set in Table D-3. If the comparison test result indicated that selenium concentrations were lower in the post-NTCRA data set than in the pre-NTCRA data set, then the NTCRA is effective in reducing selenium concentrations at the specified monitoring location.

Tests for trends were performed instead of the two-sample comparison tests when pre-NTCRA data were either not available (e.g., at monitoring well GW-22, only one sample was collected before the 2006 NTCRA was implemented) or were too limited (<5 samples) to allow for use of a comparison test at an acceptable confidence level. A non-parametric test for trend, Sen's slope estimator, was performed for each seasonal data set using all available data (years 2000 through 2017; pre- and post-NTCRA) from the monitoring location of interest. The test was performed as a one-sided test for downward trend (decreasing concentrations over time) at the 90 percent confidence level. Sen's test was selected over a linear regression method for trend testing because most of the data did not conform to the distributional assumptions that must be met for linear regression analysis. Sen's test is a simple, non-parametric procedure that allows for an estimate of the slope for selenium concentrations over time. A positive slope estimate indicates increasing concentrations over time, and a negative slope estimate indicates decreasing concentrations over time. With sufficient data, the test also provides a confidence interval for the slope estimate so that the slope can be estimated at a target 90 percent confidence level.

The variance of the selenium concentration data over time and the presence of potential outlier values in the individually tested data were also evaluated and considered in interpretation of the test results. For each of the key monitoring locations, a time-series plot of total selenium concentrations measured from 2000 through 2018 was prepared as a visual reference for interpretation of the test results. The individual time-series plots are included at the end of this appendix.

[2] USEPA Unified Guidance (USEPA 2009), Section 16.1.

[3] USEPA Unified Guidance (USEPA 2009), Section 16.2.

D.1.1 Results of Statistical Tests for Selenium Concentrations

Data sets compiled to test for differences between the pre- and post-NTCRA selenium concentrations at each location are presented in Table D-1. Two sets (Spring-Summer and Fall-Winter) of paired data were compiled for each of the key monitoring locations to represent pre-NTCRA and post-NTCRA conditions (in reference to the 2006 NTCRA). The number of measurement values and the mean and standard deviations for each separate data set are reported in Table D-3 along with a description of the appropriate type of comparison test performed for each paired data set. The results of the comparison tests are also reported.

Statistically significant changes in selenium concentrations, relative to completion of the 2006 NTCRA, were observed at the locations identified in Table D-4.

At the other locations and seasonal time-periods, either the selenium concentrations remained unchanged, or no statistically significant differences in the pre- and post-NTCRA selenium concentrations were confirmed at the target 90 percent confidence level. Ongoing monitoring will provide the additional data to confirm statistically significant changes in selenium concentrations at the effectiveness monitoring locations.

Table D-4. Statistically Significant Changes in Selenium Concentrations in 2018.

Monitoring Location	Season	Conclusion Based on Statistical Evaluation (at desired level of confidence)
Alluvial groundwater GW-15	Fall-Winter	Selenium concentration decreased after implementation of 2006 NTCRA.
	Spring-Summer [a]	
Wells Formation groundwater GW-16	Fall-Winter	Selenium concentration increased after implementation of 2006 NTCRA. [c]
	Spring-Summer	
Lower Pole Canyon Creek LP/LP-PD [b]	Spring-Summer [a]	Selenium concentration decreased after implementation of 2006 NTCRA.
Sage Creek above Hoopes Spring LSV-1 [b]	Fall-Winter	Selenium concentrations decreasing over time.
	Spring-Summer [a]	Selenium concentration decreased after implementation of 2006 NTCRA.
North Fork of Sage Creek NSV-6 [b]	Fall-Winter	Selenium concentrations decreasing over time.
	Spring-Summer [a]	Selenium concentration increased after implementation of 2006 NTCRA.

Notes:

[a] The selenium result for the GW-15, LP-PD, LSV-1, and NSV-6 samples collected in June 14-15, 2011 was not included in the data used for statistical analysis because the sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result is not considered representative of typical post-NTCRA conditions.

[b] Note that some of the source data for location LP-PD, LSV-1, and NSV-6 are estimated values due to selenium concentrations less than the Practical Quantitation Limit (PQL). The statistically significant decreases at these locations are less certain than for locations with values reported above the PQL.

[c] Although the results of the statistical analysis suggest that selenium concentrations have increased since implementation of the 2006 NTCRA, the time series plot for GW-16 shows that more recently, selenium concentrations in groundwater have decreased since implementation of the 2013 NTCRA.

D.1.2 Results of Statistical Tests for Selenium Mass Loads

The same type of statistical analysis was planned using calculated selenium mass-load results from key surface water monitoring locations on lower Pole Canyon Creek (LP/LP-PD), North Fork Sage Creek (NSV-6), and Sage Creek above Hoopes Spring (LSV-1). As for the selenium concentration data, two sets (Spring-Summer and Fall-Winter seasonal data) of paired data (pre-NTCRA and post-NTCRA) were compiled for each of these three locations.

The selenium mass-load data compiled for this effort are provided in Tables D-5 through D-7. The data include the measured selenium concentration and flow and the calculated selenium mass load for each sampling event for which both concentration and flow data were available. When the pre-NTCRA and post-NTCRA flow data were assembled for these three locations, it became apparent that flows measured in pre-NTCRA years (primarily 2002, 2003, and 2004) were not comparable to the flows measured at the same locations in post-NTCRA years (since late 2007) due to the effects of regional drought conditions that existed from approximately 2000 through 2005. This effect is evident in the Spring-Summer (i.e., high-flow) data but not as clear in the Fall-Winter (i.e., low-flow) data. As a result, the Spring-Summer flows measured in the pre-NTCRA years are consistently lower than in the post-NTCRA years. For this reason, selenium mass loads computed using flows from drought years are not comparable to selenium mass loads computed using more typical, non-drought flows measured at the same locations in recent years.

The planned statistical testing was not applied to the Spring-Summer selenium mass load data because the pre- and post-NTCRA seasonal data do not represent comparable surface water flow conditions, as needed to specifically assess the effectiveness of the 2006 NTCRA for limiting the selenium mass loads in surface water. However, the Fall-Winter selenium mass load data were tested.

Sen's slope estimator was the trend test applied to the post-NTRCA Fall-Winter mass load data from LP/LP-PD (lower Pole Canyon Creek), NSV-6, and LSV-1. For NSV-6, a statistically significant decreasing trend was detected at the 90 percent confidence level (note: no selenium mass load data are available for location NSV-6 from 2011 thru 2014). For LP/LP-PD and LSV-1, neither increasing nor decreasing trends in selenium mass loads were demonstrated at the 90 percent confidence level. Additional data are needed to confirm changes in selenium mass loads at these locations.

D.2 References

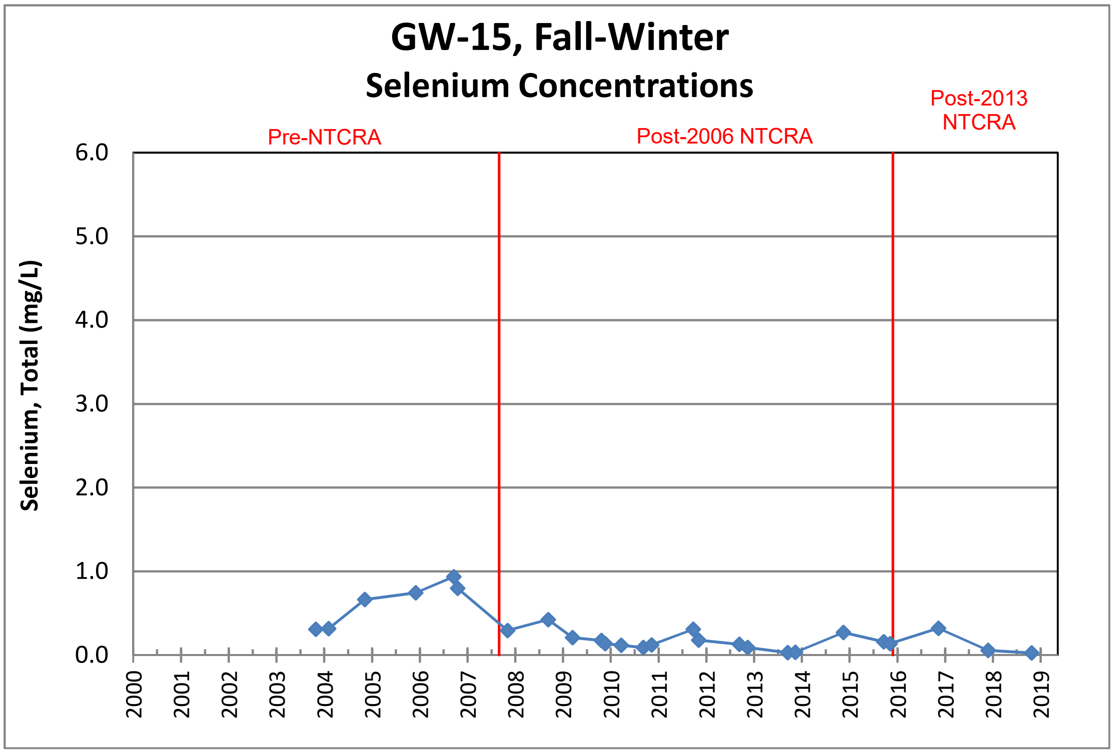
Formation Environmental, LLC (Formation). 2018. Revision No. 5 Pole Canyon Non-Time-Critical Removal Action Effectiveness Monitoring Plan. Prepared for J.R. Simplot Company, March 2018.

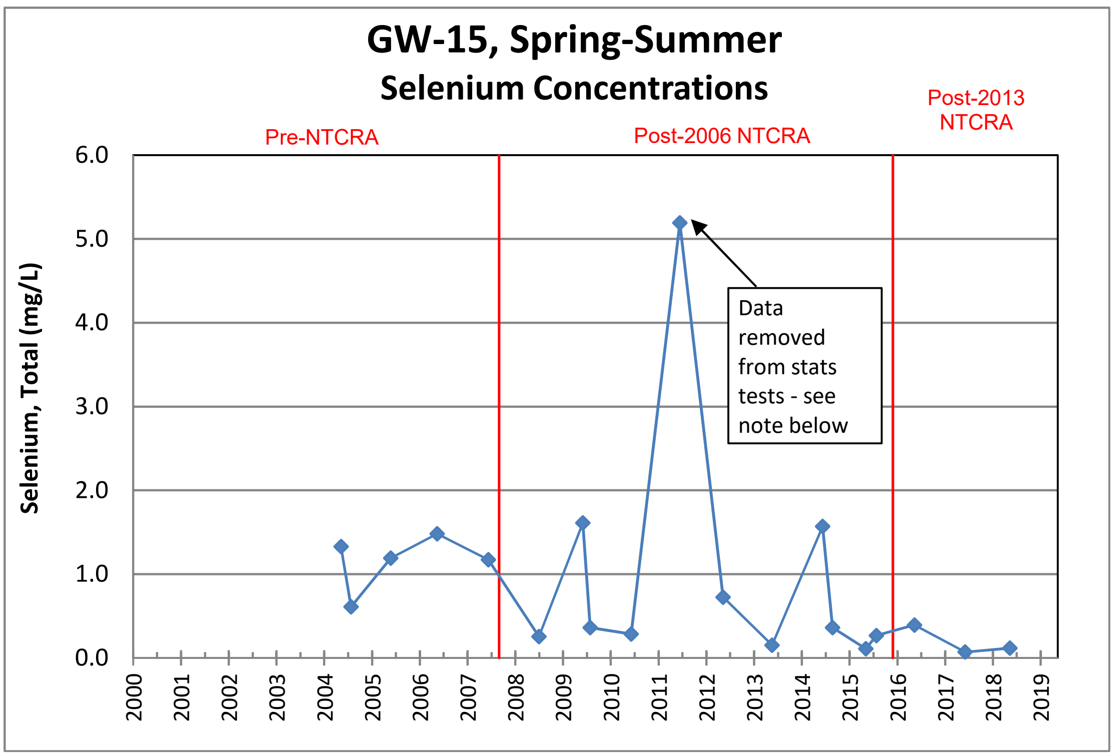
United States Department of Agriculture, Forest Service Region 4, US Environmental Protection Agency Region 10, Idaho Department of Environmental Quality (USFS, USEPA, and IDEQ). 2006. Administrative Settlement Agreement and Order on Consent/Consent Order for Non-Time-Critical Removal Action, Smoky Canyon Phosphate Mine, J.R. Simplot Company Respondent. Signed October 2, 2006.

United States Department of Agriculture, Forest Service Region 4, Idaho Department of Environmental Quality, Shoshone-Bannock Tribes (USFS, IDEQ, and Tribes). 2013. Administrative Settlement Agreement and Order on Consent/Consent Order for Non-Time-Critical Removal Action, Smoky Canyon Phosphate Mine. J.R. Simplot Company Respondent. Signed November 27, 2013.

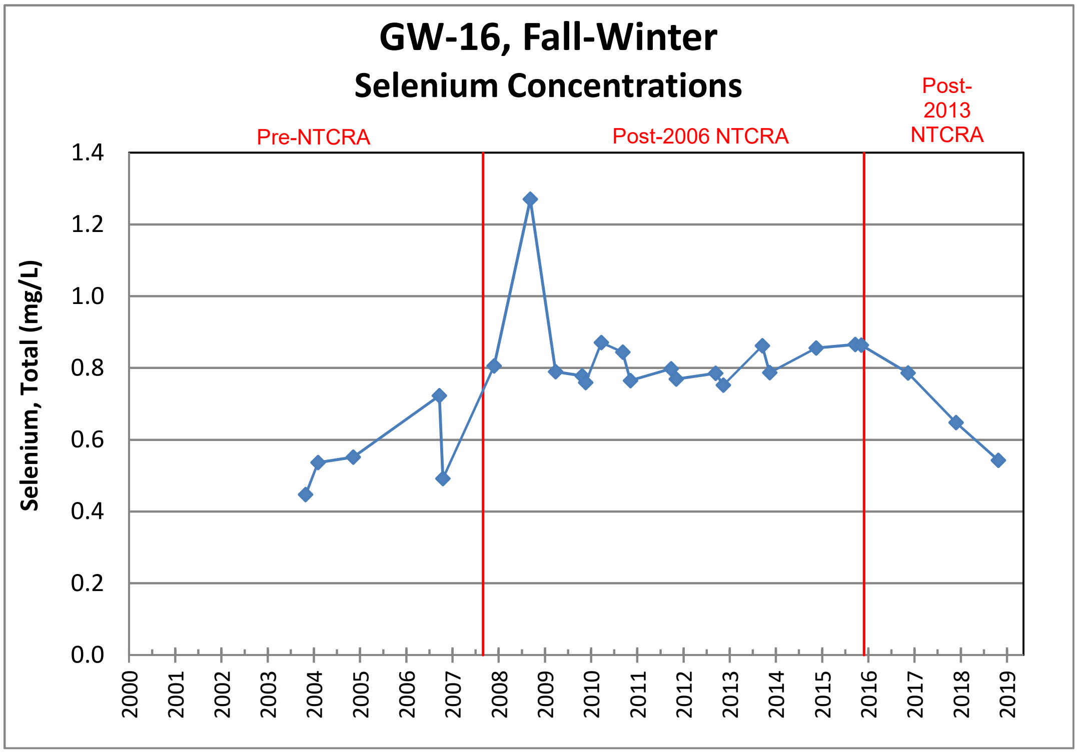
United States Environmental Protection Agency (USEPA). 2006. Guidance for the Data Quality Objectives Process, EPA QA/G-4, Office of Environmental Information, EPA/240/B-06/001.

United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, March 2009, EPA 530/R-09-007.





Note: The June 15, 2011 sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result associated with this sample is not considered representative of typical post-NTRCRA conditions and the result has been excluded from statistical comparison tests performed for GW-15 (spring-summer season).


GW-16, Fall-Winter
Selenium Concentrations
Pre-NTCRA
Post-2006 NTCRA
Post-2013 NTCRA
Selenium, Total (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
2000
2001
2002
2003
2004
2005
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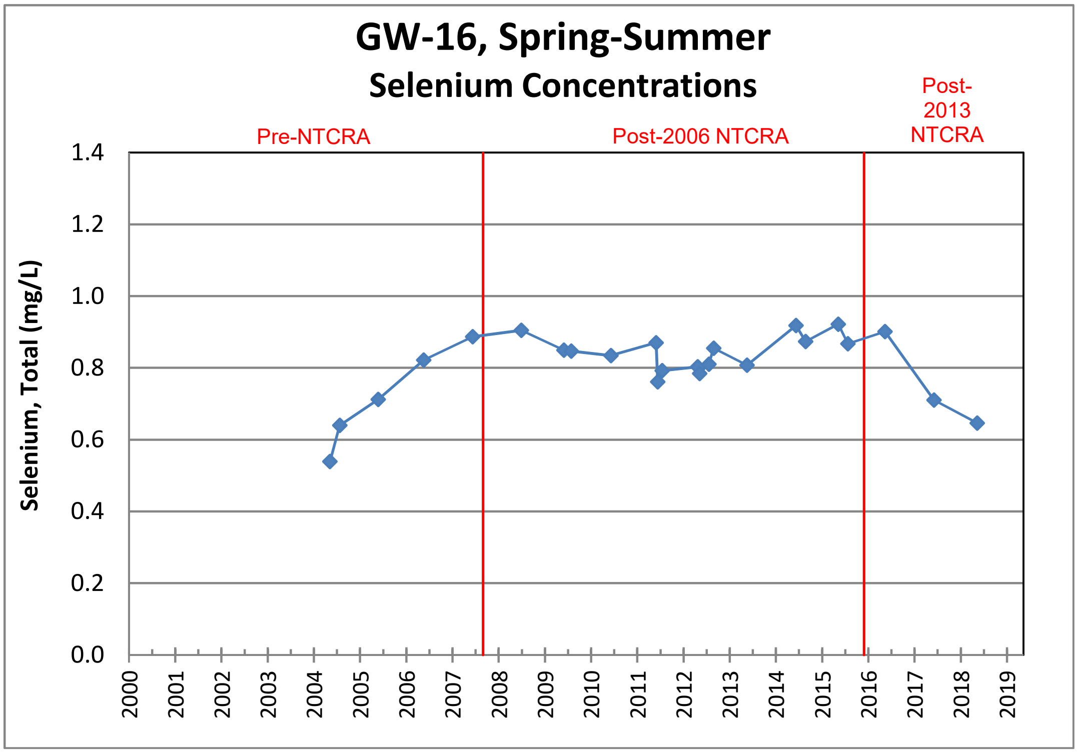
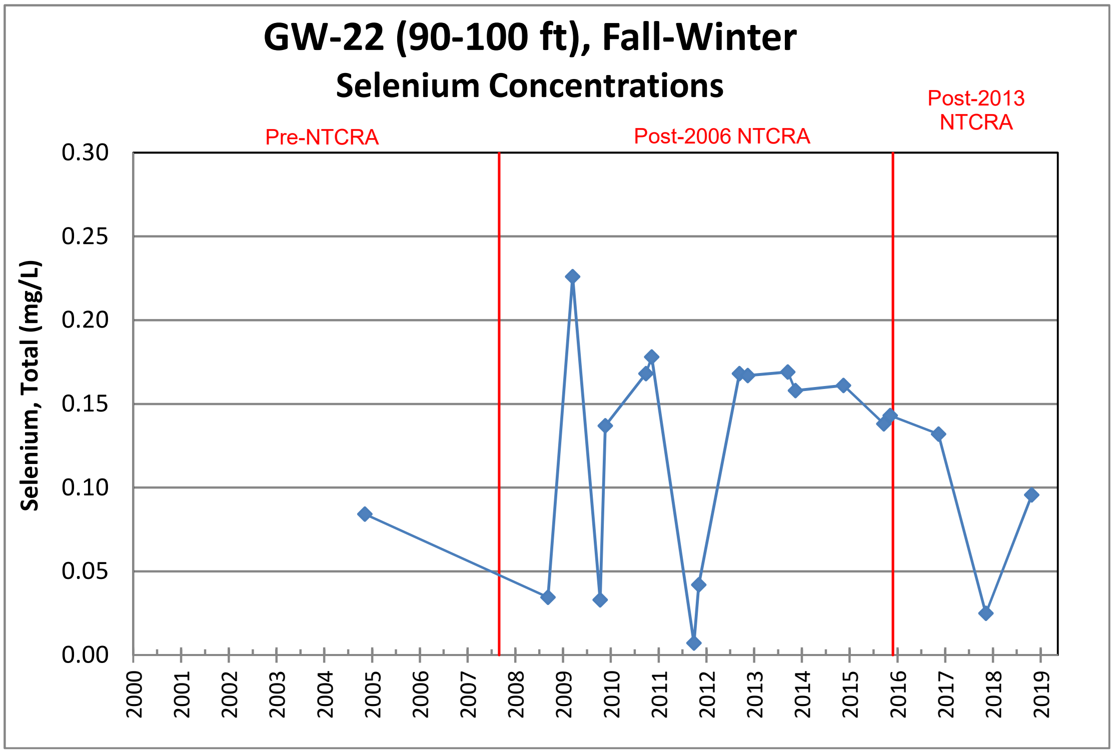
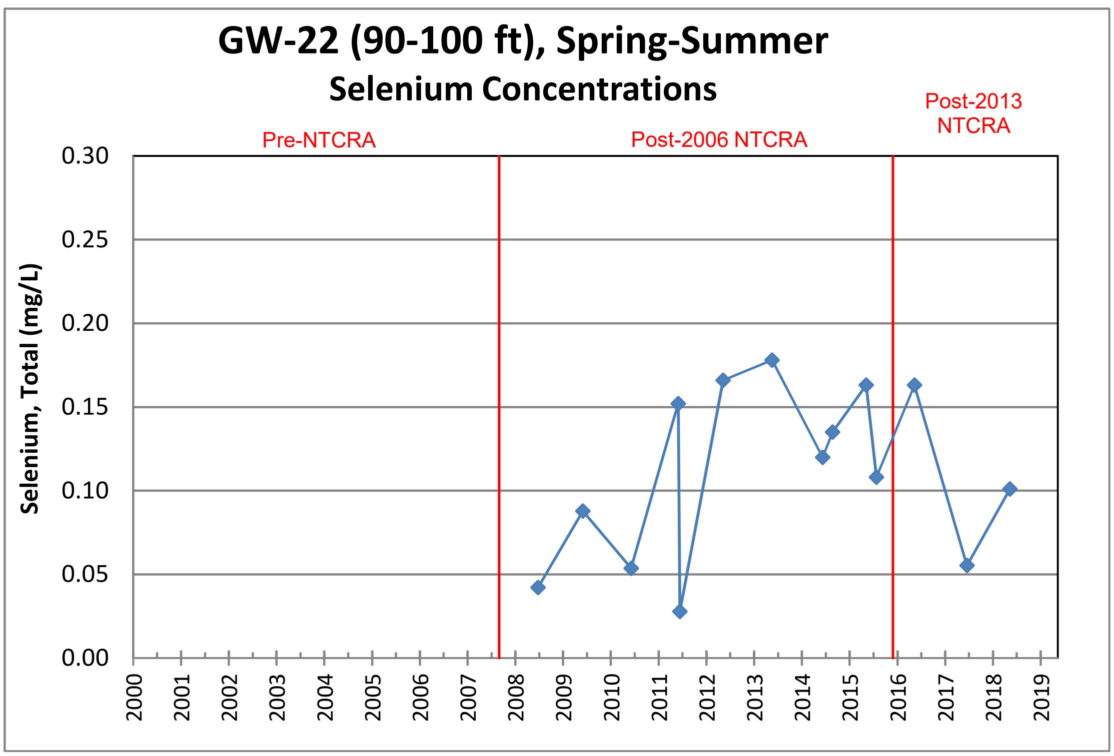
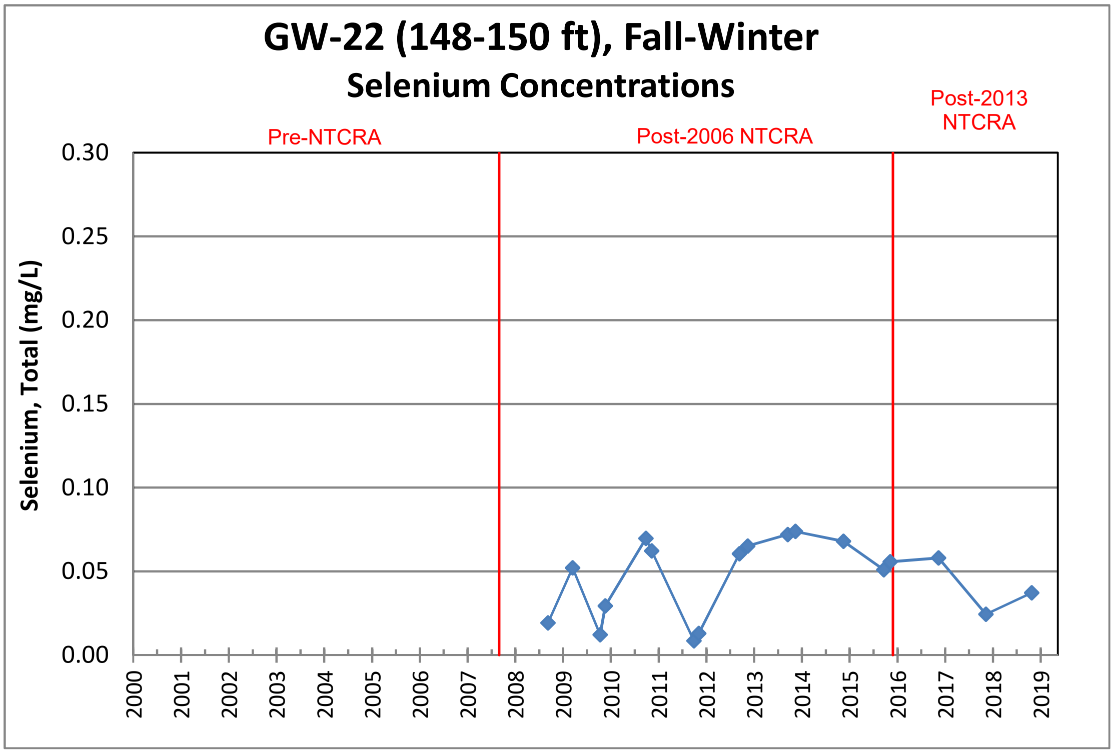
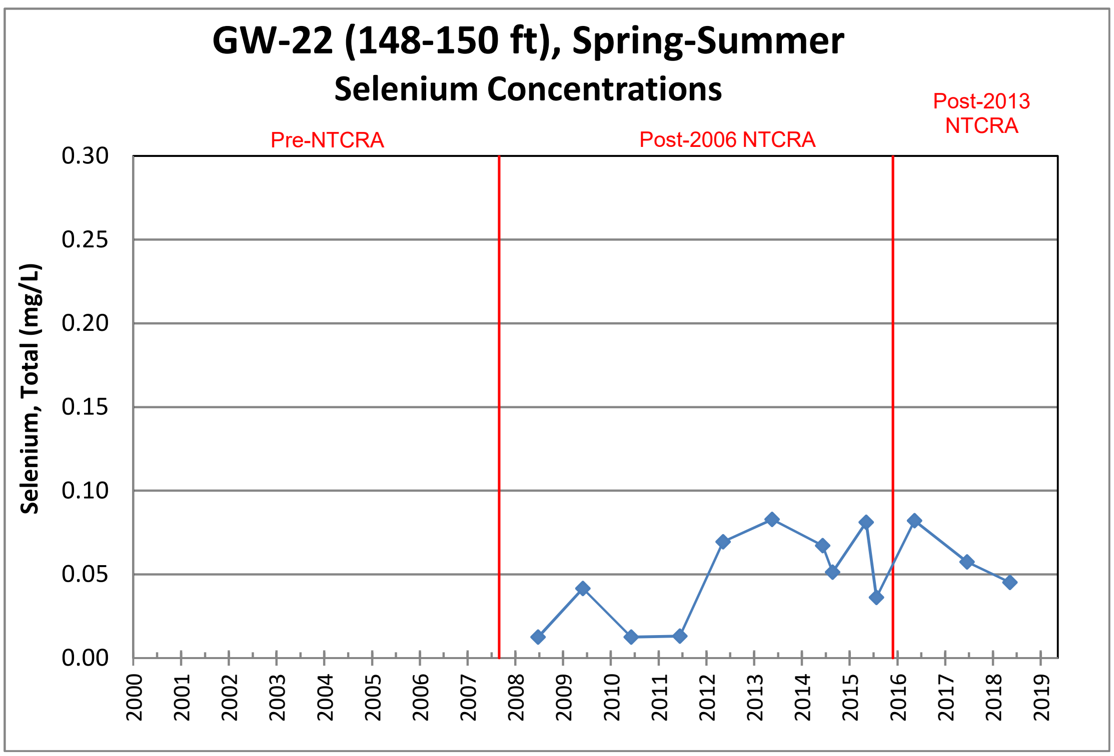
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

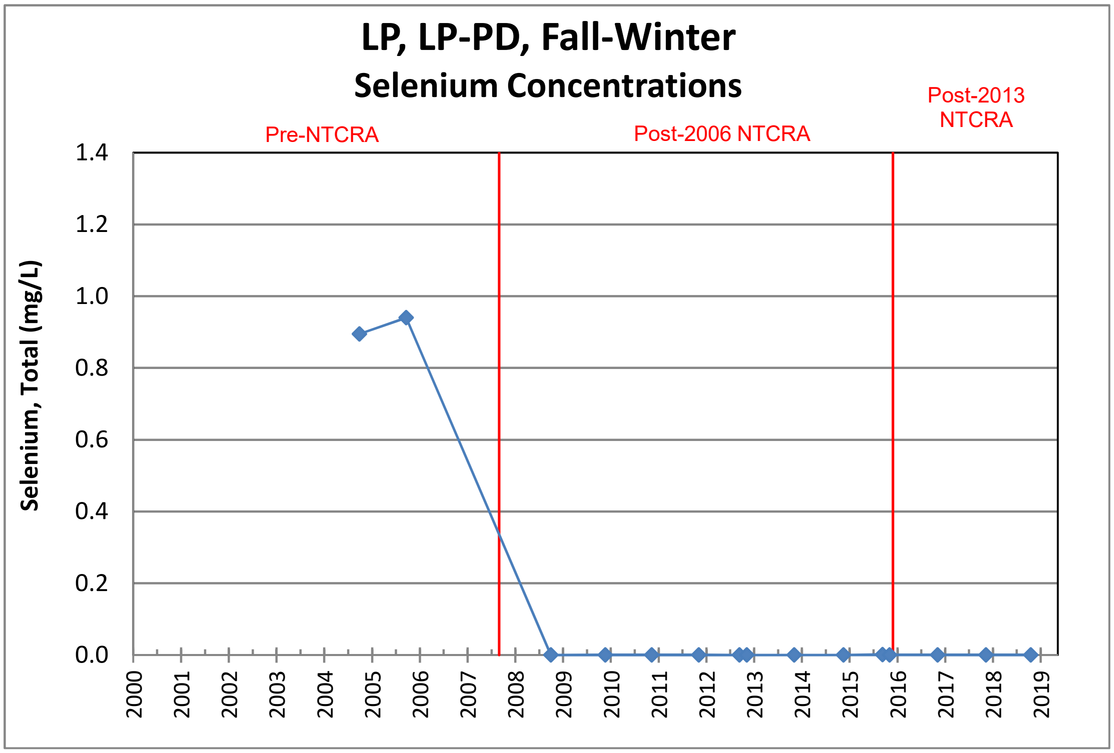

GW-16, Spring-Summer
Selenium Concentrations
Pre-NTCRA
Post-2006 NTCRA
Post-2013 NTCRA
Selenium, Total (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

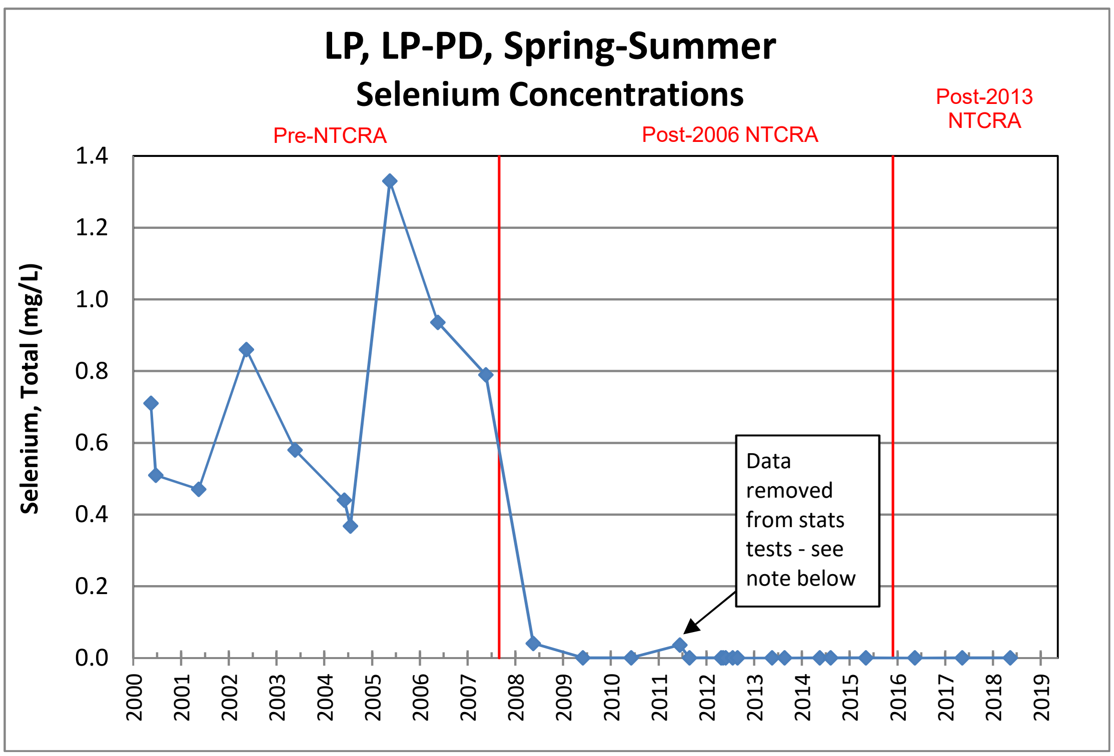

GW-22 (90-100 ft), Fall-Winter
Selenium Concentrations
Pre-NTCRA
Post-2006 NTCRA
Post-2013 NTCRA
Selenium, Total (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019


GW-22 (90-100 ft), Spring-Summer
Selenium Concentrations
Pre-NTCRA
Post-2006 NTCRA
Post-2013 NTCRA
Selenium, Total (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

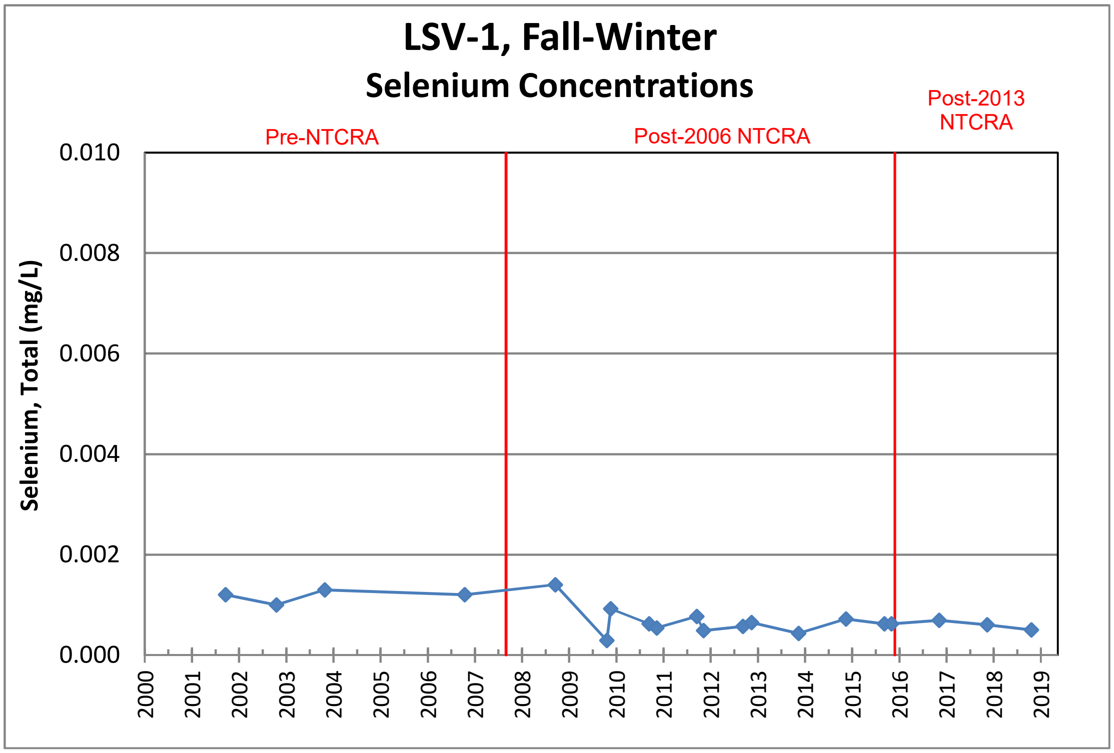

GW-22 (148-150 ft), Fall-Winter
Selenium Concentrations
Pre-NTCRA
Post-2006 NTCRA
Post-2013 NTCRA
Selenium, Total (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

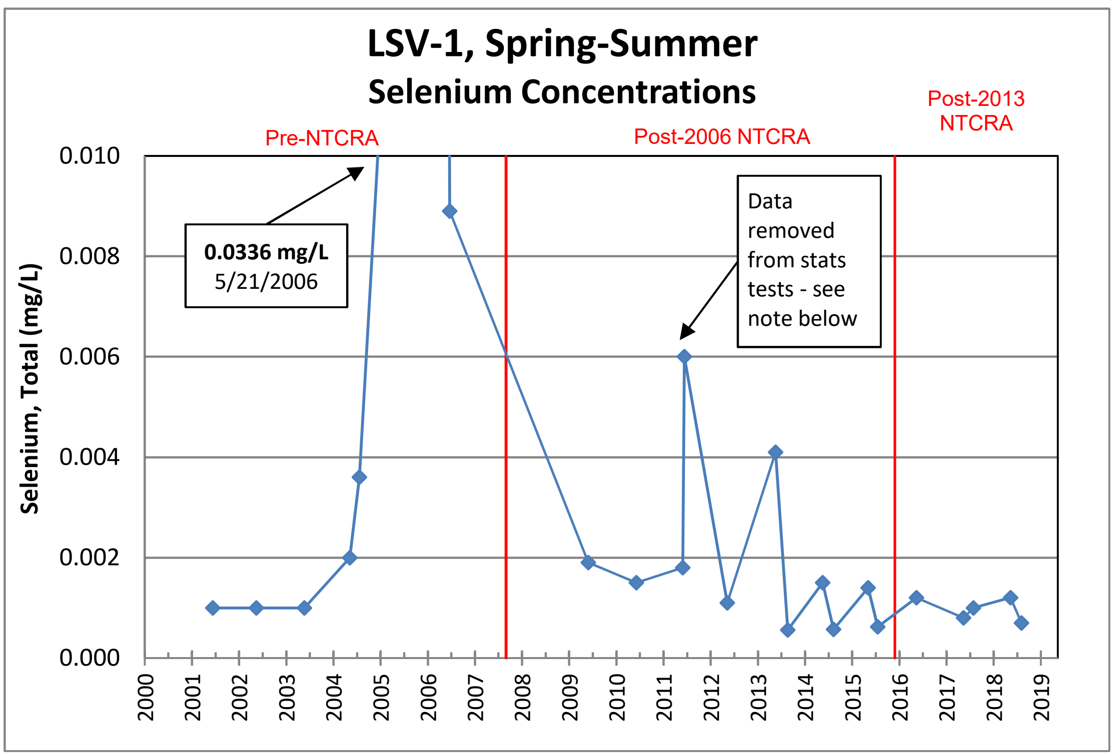

GW-22 (148-150 ft), Spring-Summer
Selenium Concentrations
Pre-NTCRA
Post-2006 NTCRA
Post-2013 NTCRA
Selenium, Total (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019



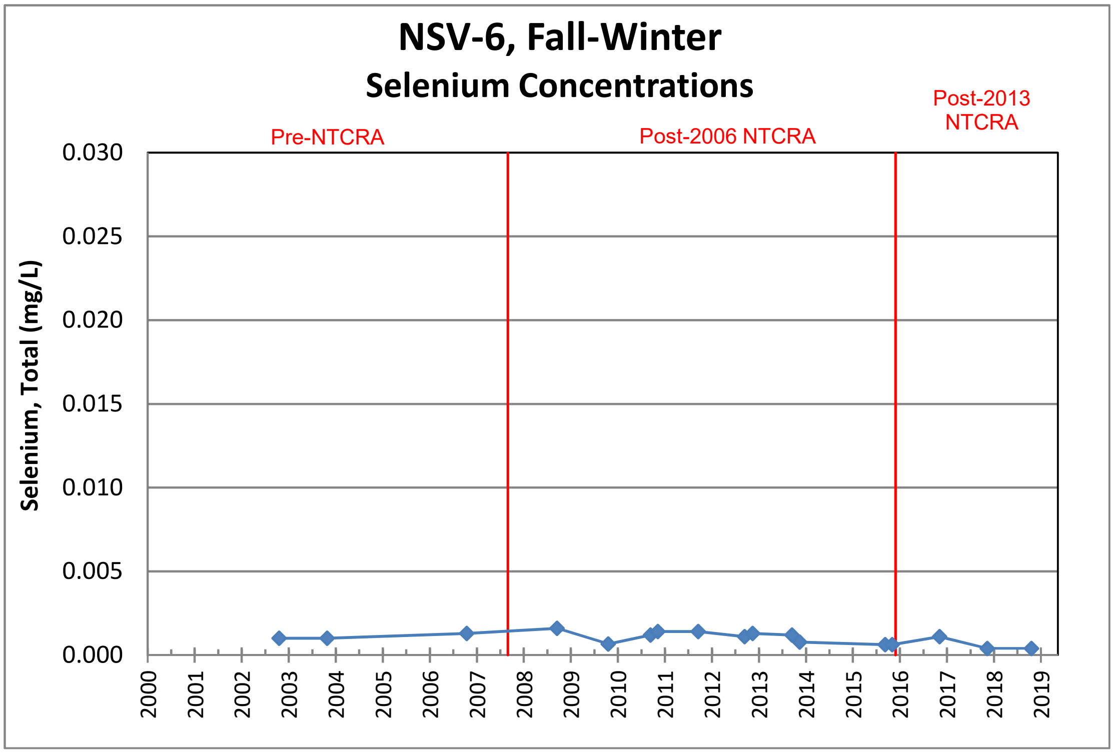


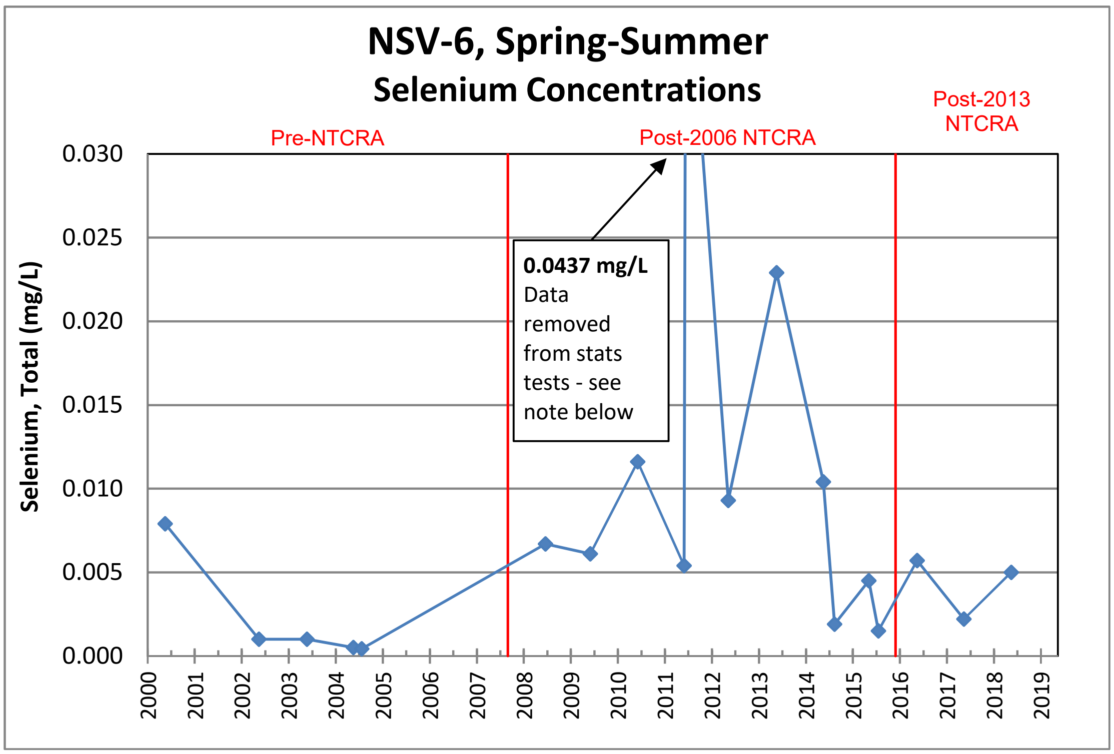
Note: The June 14, 2011 sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result associated with this sample is not considered representative of typical post-NTRCRA conditions and the result has been excluded from statistical comparison tests performed for LP-PD (spring-summer season).



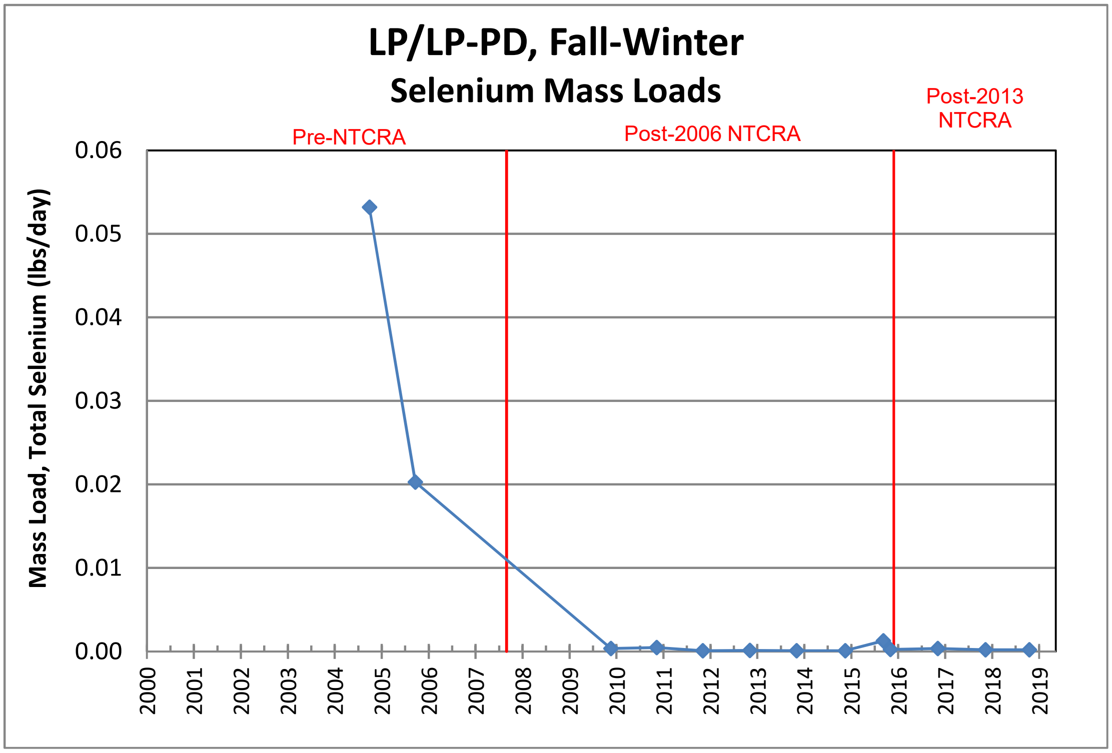


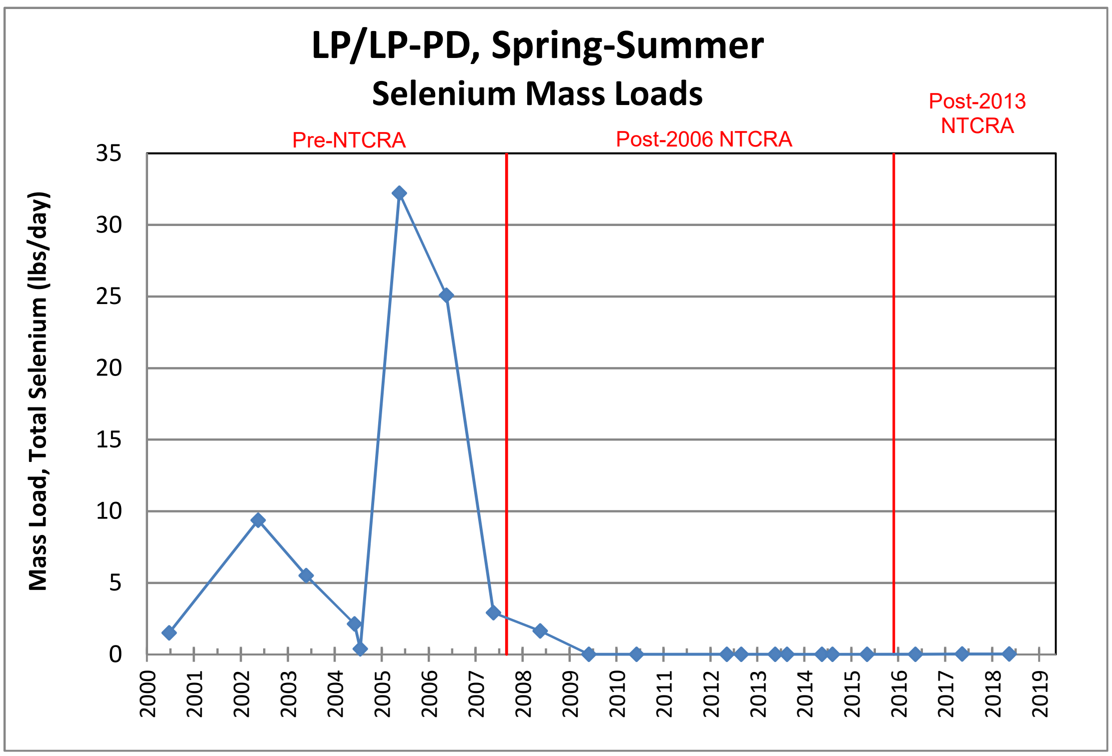
Note: The June 14, 2011 sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result associated with this sample is not considered representative of typical post-NTRCRA conditions and the result has been excluded from statistical comparison tests performed for LSV-1 (spring-summer season).

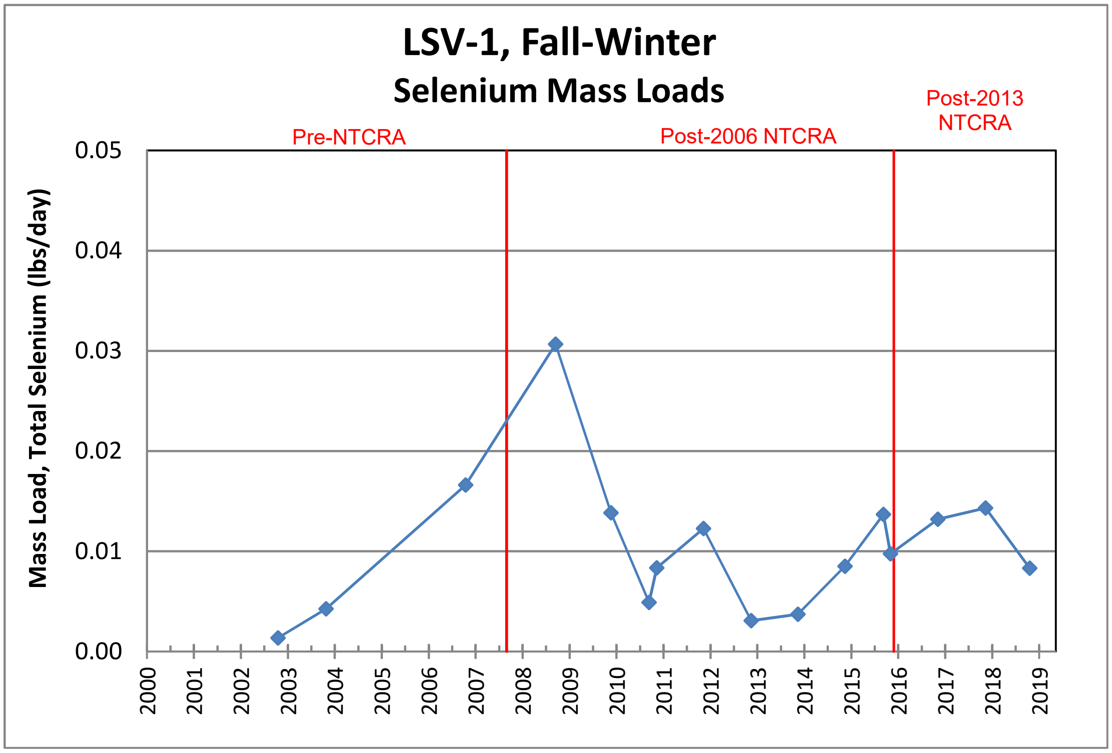


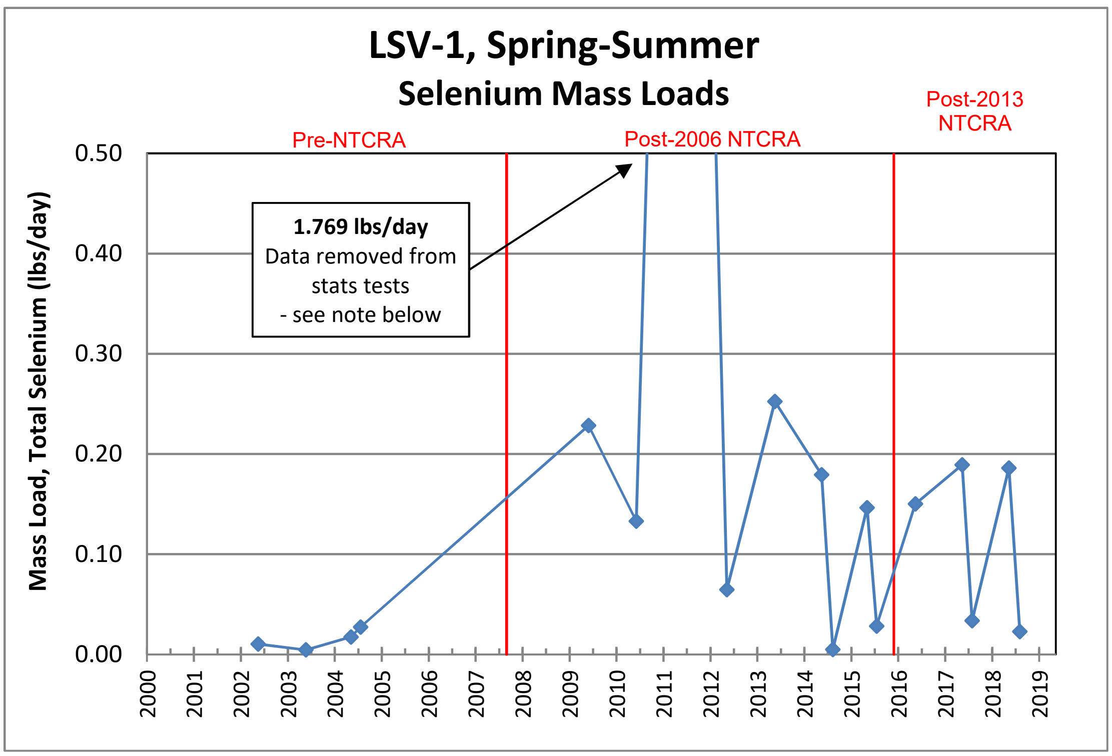


Note: The June 14, 2011 sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result associated with this sample is not considered representative of typical post-NTRCRA conditions and the result has been excluded from statistical comparison tests performed for NSV-6 (spring-summer season).

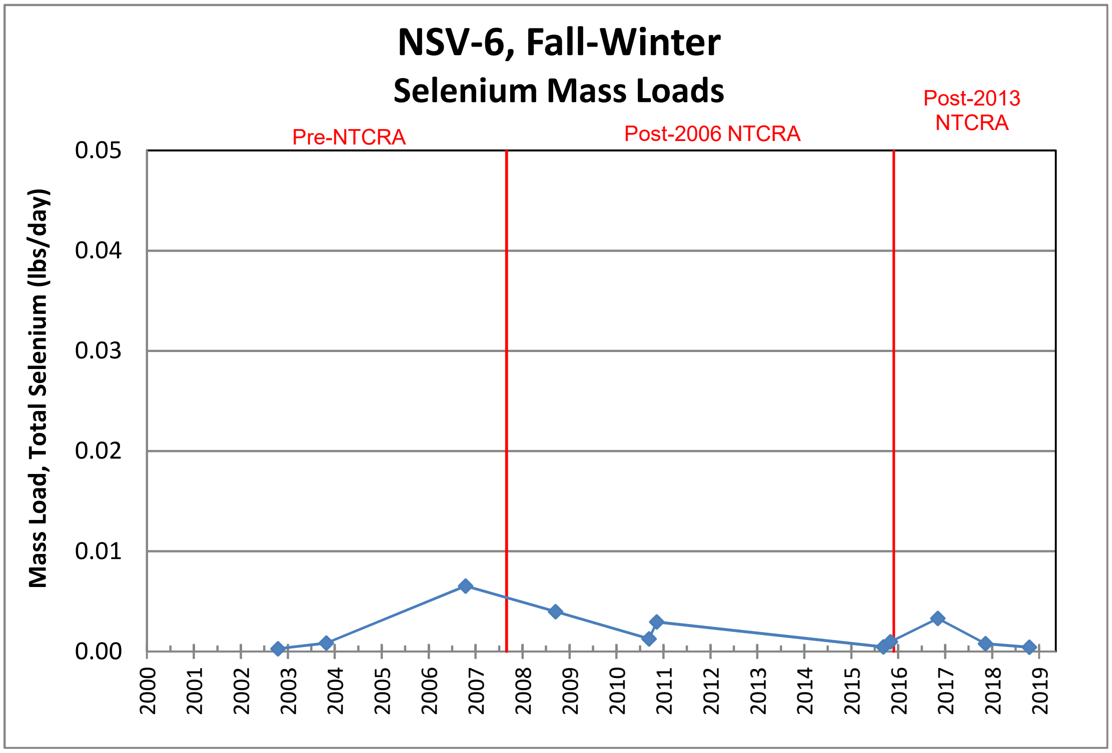

LP/LP-PD, Fall-Winter
Selenium Mass Loads
Pre-NTCRA
Post-2006 NTCRA
Post-2013 NTCRA
Mass Load, Total Selenium (lbs/day)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

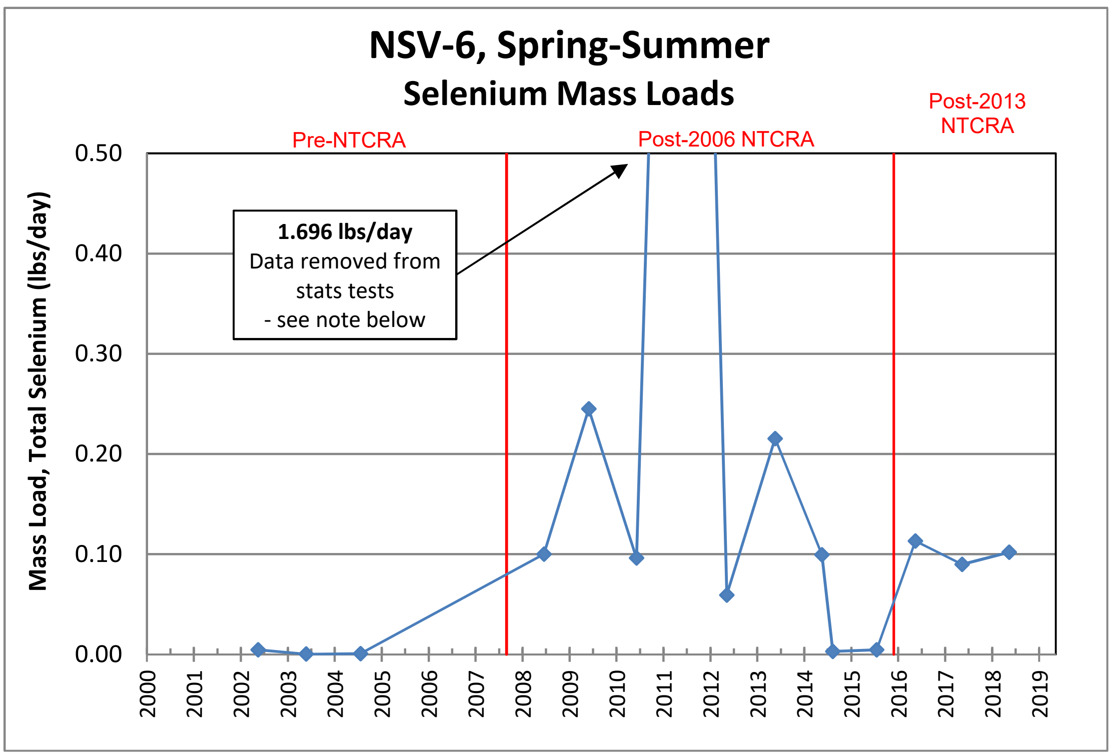

LP/LP-PD, Spring-Summer
Selenium Mass Loads
Pre-NTCRA
Post-2006 NTCRA
Post-2013 NTCRA
Mass Load, Total Selenium (lbs/day)
35
30
25
20
15
10
5
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019





Note: The June 14, 2011 sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result associated with this sample is not considered representative of typical post-NTRCRA conditions and the result has been excluded from statistical comparison tests performed for LSV-1 (spring-summer season).





Note: The June 14, 2011 sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result associated with this sample is not considered representative of typical post-NTRCRA conditions and the result has been excluded from statistical comparison tests performed for NSV-6 (spring-summer season).

Table D-1. Monitoring Data Used for 2018 Statistical Evaluations

Monitoring Location	Sample Media	Season	Date	Selenium, Total (mg/L)	MDL (mg/L)	PQL (mg/L)	Lab Qualifier[1]	Analytical Method	Laboratory
Alluvial GW: GW-15	**GW**	**Fall-Winter**							
Pre-NTCRA Time Period									
GW-15	GW	Fall-Winter	10/29/2003	0.309	0.01	0.05		SM3114C	SVL
			2/4/2004	0.317	0.01	0.05		SM3114C	SVL
			11/8/2004	0.664	0.015	0.05		SM3114C	SVL
			12/1/2005	0.742	0.04	0.2		SM3114C	SVL
			9/20/2006	0.936	0.02	0.2		SM3114C	SVL
			10/18/2006	0.796	0.04	Not reported		SM3114C	SVL
Post-NTCRA Time Period									
GW-15	GW	Fall-Winter	11/5/2007	0.293	0.01	2	B	SM3114C	SVL
			9/10/2008	0.422	0.02	0.2		SM3114C	SVL
			3/16/2009	0.207	0.004	0.04		SM3114C	SVL
			10/23/2009	0.175	0.005	0.05		SM3114C	SVL
			11/21/2009	0.136	0.004	0.04		SM3114C	SVL
			3/25/2010	0.116	0.002	0.02		SM3114C	SVL
			9/10/2010	0.0897	0.002	0.02		SM3114C	SVL
			11/11/2010	0.119	0.002	0.02		SM3114C	SVL
			9/27/2011	0.31	0.01	0.1		SM3114C	SVL
			11/7/2011	0.18	0.004	0.04		SM3114C	SVL
			9/13/2012	0.128	0.002	0.02		SM 3114C	SVL
			11/15/2012	0.0892	0.002	0.02		SM 3114C	SVL
			9/18/2013	0.0309	0.001	0.01		SM 3114C	SVL
			11/15/2013	0.0341	0.0006	0.006		SM 3114C	SVL
			11/19/2014	0.27	0.01	0.1		SM 3114C	SVL
			9/22/2015	0.158	0.00062	0.002		EPA 6020A	SVL
			11/11/2015	0.136	0.00011	0.002		EPA 6020A	SVL
			11/15/2016	0.321	0.00024	0.002		EPA 6020A	SVL
			11/29/2017	0.0563	0.0004	0.002		EPA 6020A	SVL
			10/29/2018	0.0247	0.0002	0.002		EPA 6020B	SVL
Alluvial GW: GW-15	**GW**	**Spring-Summer**							
Pre-NTCRA Time Period									
GW-15	GW	Spring-Summer	5/9/2004	1.33	0.06	0.2		SM3114C	SVL
			7/25/2004	0.61	0.015	0.05		SM3114C	SVL
			5/25/2005	1.19	0.02	0.2		SM3114C	SVL
			5/16/2006	1.48	0.04	0.4		SM3114C	SVL
			6/12/2007	1.17	0.013	0.03		SM3114C	SVL
Post-NTCRA Time Period									
GW-15	GW	Spring-Summer[a]	7/1/2008	0.255	0.02	0.2		SM3114C	SVL
			6/2/2009	1.61	0.02	0.2		SM3114C	SVL
			7/30/2009	0.363	0.008	0.08		SM3114C	SVL
			6/8/2010	0.286	0.004	0.04		SM3114C	SVL
			6/15/2011	5.19	0.2	2		SM3114C	SVL
			5/11/2012	0.724	0.02	0.2		SM 3114C	SVL
			5/21/2013	0.15	0.002	0.02		SM 3114C	SVL
			6/11/2014	1.57	0.04	0.4		SM 3114C	SVL
			8/26/2014	0.362	0.02	0.2		SM 3114C	SVL
			5/8/2015	0.109	0.00062	0.002		EPA 6020A	SVL
			7/28/2015	0.265	0.00011	0.002		EPA 6020A	SVL
			5/16/2016	0.391	0.00024	0.002		EPA 6020A	SVL
			6/6/2017	0.0699	0.0004	0.002		EPA 6020A	SVL
			5/15/2018	0.118	0.0002	0.002		EPA 6020B	SVL

Table D-1. Monitoring Data Used for 2018 Statistical Evaluations

Monitoring Location	Sample Media	Season	Date	Selenium, Total (mg/L)	MDL (mg/L)	PQL (mg/L)	Lab Qualifier[1]	Analytical Method	Laboratory
Wells Fm GW: GW-16	**GW**	**Fall-Winter**							
Pre-NTCRA Time Period									
GW-16	GW	Fall-Winter	10/29/2003	0.447	0.008	0.04		SM3114C	SVL
			2/3/2004	0.536	0.01	0.05		SM3114C	SVL
			11/8/2004	0.552	0.015	0.05		SM3114C	SVL
			9/20/2006	0.723	0.02	0.2		SM3114C	SVL
			10/18/2006	0.492	0.04	Not reported		SM3114C	SVL
Post-NTCRA Time Period									
GW-16	GW	Fall-Winter	11/28/2007	0.806	0.02	0.2		SM3114C	SVL
			9/10/2008	1.27	0.04	0.4		SM3114C	SVL
			3/27/2009	0.79	0.02	0.2		SM3114C	SVL
			10/25/2009	0.778	0.01	0.1		SM3114C	SVL
			11/21/2009	0.759	0.02	0.2		SM3114C	SVL
			3/25/2010	0.871	0.02	0.2		SM3114C	SVL
			9/10/2010	0.844	0.02	0.2		SM3114C	SVL
			11/11/2010	0.765	0.02	0.2		SM3114C	SVL
			9/27/2011	0.798	0.02	0.2		SM3114C	SVL
			11/7/2011	0.769	0.02	0.2		SM3114C	SVL
			9/13/2012	0.785	0.02	0.2		SM 3114C	SVL
			11/15/2012	0.752	0.02	0.2		SM 3114C	SVL
			9/18/2013	0.862	0.02	0.2		SM 3114C	SVL
			11/15/2013	0.787	0.02	0.2		SM 3114C	SVL
			11/19/2014	0.856	0.02	0.2		SM 3114C	SVL
			9/22/2015	0.865	0.00062	0.002		EPA 6020A	SVL
			11/11/2015	0.864	0.00011	0.002		EPA 6020A	SVL
			11/14/2016	0.786	0.00024	0.002		EPA 6020A	SVL
			11/28/2017	0.648	0.0004	0.002		EPA 6020A	SVL
			10/29/2018	0.543	0.0002	0.002		EPA 6020B	SVL
Wells Fm GW: GW-16	**GW**	**Spring-Summer**							
Pre-NTCRA Time Period									
GW-16	GW	Spring-Summer	5/9/2004	0.539	0.015	0.05		SM3114C	SVL
			7/25/2004	0.64	0.015	0.05		SM3114C	SVL
			5/26/2005	0.712	0.02	0.2		SM3114C	SVL
			5/19/2006	0.822	0.02	0.2		SM3114C	SVL
			6/12/2007	0.887	0.013	0.03		SM3114C	SVL
Post-NTCRA Time Period									
GW-16	GW	Spring-Summer	7/1/2008	0.905	0.02	0.2		SM3114C	SVL
			6/2/2009	0.849	0.02	0.2		SM3114C	SVL
			7/30/2009	0.847	0.02	0.2		SM3114C	SVL
			6/8/2010	0.834	0.02	0.2		SM3114C	SVL
			6/2/2011	0.87	0.01	0.1		SM3114C	SVL
			6/15/2011	0.761	0.02	0.2		SM3114C	SVL
			7/19/2011	0.792	0.02	0.2		SM3114C	SVL
			4/25/2012	0.803	0.02	0.2		SM 3114C	SVL
			5/11/2012	0.784	0.02	0.2		SM 3114C	SVL
			7/23/2012	0.81	0.02	0.2		SM 3114C	SVL
			8/30/2012	0.855	0.01	0.1		SM 3114C	SVL
			5/21/2013	0.807	0.02	0.2		SM 3114C	SVL
			6/11/2014	0.918	0.02	0.2		SM 3114C	SVL
			8/26/2014	0.873	0.02	0.2		SM 3114C	SVL
			5/11/2015	0.922	0.00062	0.002		EPA 6020A	SVL
			7/28/2015	0.867	0.00011	0.002		EPA 6020A	SVL
			5/16/2016	0.901	0.00024	0.002		EPA 6020A	SVL
			6/6/2017	0.71	0.0004	0.002		EPA 6020A	SVL
			5/15/2018	0.646	0.0002	0.002		EPA 6020B	SVL

Table D-1. Monitoring Data Used for 2018 Statistical Evaluations

Monitoring Location	Sample Media	Season	Date	Selenium, Total (mg/L)	MDL (mg/L)	PQL (mg/L)	Lab Qualifier[1]	Analytical Method	Laboratory
Alluvial GW: GW-22, 90-100 ft	**GW**	**Fall-Winter**							
Pre-NTCRA Time Period									
GW-22, 90-100 ft	GW	Fall-Winter	11/8/2004	0.0841	0.003	0.01		SM3114C	SVL
Post-NTCRA Time Period									
GW-22, 90-100 ft	GW	Fall-Winter	9/9/2008	0.0346	0.001	0.01		SM3114C	SVL
			3/16/2009	0.226	0.004	0.04		SM3114C	SVL
			10/12/2009	0.0329	0.0004	0.004		SM3114C	SVL
			11/22/2009	0.137	0.004	0.04		SM3114C	SVL
			9/29/2010	0.168	0.002	0.02		SM3114C	SVL
			11/11/2010	0.178	0.004	0.04		SM3114C	SVL
			10/1/2011	0.0072	0.0002	0.002		SM3114C	SVL
			11/7/2011	0.042	0.001	0.01		SM3114C	SVL
			9/13/2012	0.168	0.004	0.04		SM 3114C	SVL
			11/15/2012	0.167	0.002	0.02		SM 3114C	SVL
			9/18/2013	0.169	0.002	0.02		SM 3114C	SVL
			11/15/2013	0.158	0.002	0.02		SM 3114C	SVL
			11/19/2014	0.161	0.004	0.04		SM 3114C	SVL
			9/22/2015	0.138	0.00062	0.002		EPA 6020A	SVL
			11/11/2015	0.143	0.00011	0.002		EPA 6020A	SVL
			11/14/2016	0.132	0.00024	0.002		EPA 6020A	SVL
			11/13/2017	0.0249	0.0004	0.002		EPA 6020A	SVL
			10/29/2018	0.0957	0.0002	0.002		EPA 6020B	SVL
Alluvial GW: GW-22, 90-100 ft	**SW**	**Spring-Summer**							
Post-NTCRA Time Period									
GW-22, 90-100 ft	GW	Spring-Summer	6/25/2008	0.0421	0.002	0.02		SM3114C	SVL
			6/2/2009	0.0878	0.002	0.02		SM3114C	SVL
			6/8/2010	0.0537	0.002	0.02		SM3114C	SVL
			6/2/2011	0.152	0.002	0.02		SM3114C	SVL
			6/15/2011	0.0278	0.0008	0.008		SM3114C	SVL
			5/11/2012	0.166	0.002	0.02		SM 3114C	SVL
			5/21/2013	0.178	0.002	0.02		SM 3114C	SVL
			6/11/2014	0.12	0.002	0.02		SM 3114C	SVL
			8/26/2014	0.135	0.002	0.02		SM 3114C	SVL
			5/11/2015	0.163	0.00062	0.002		EPA 6020A	SVL
			7/28/2015	0.108	0.00011	0.002		EPA 6020A	SVL
			5/16/2016	0.163	0.00024	0.002		EPA 6020A	SVL
			6/21/2017	0.0554	0.0004	0.002		EPA 6020A	SVL
			5/15/2018	0.101	0.0002	0.002		EPA 6020B	SVL

Table D-1. Monitoring Data Used for 2018 Statistical Evaluations

Monitoring Location	Sample Media	Season	Date	Selenium, Total (mg/L)	MDL (mg/L)	PQL (mg/L)	Lab Qualifier[1]	Analytical Method	Laboratory
Alluvial GW: GW-22, 148-150 ft	**GW**	**Fall-Winter**							
Post-NTCRA Time Period									
GW-22, 148-150 ft	GW	Fall-Winter	9/9/2008	0.0193	0.0002	0.002		SM3114C	SVL
			3/17/2009	0.0521	0.001	0.01		SM3114C	SVL
			10/12/2009	0.0122	0.0002	0.002		SM3114C	SVL
			11/22/2009	0.0294	0.001	0.01		SM3114C	SVL
			9/28/2010	0.0697	0.002	0.02		SM3114C	SVL
			11/11/2010	0.0623	0.001	0.01		SM3114C	SVL
			10/1/2011	0.0085	0.0002	0.002		SM3114C	SVL
			11/7/2011	0.0129	0.0002	0.002		SM3114C	SVL
			9/13/2012	0.0605	0.001	0.01		SM3114C	SVL
			11/15/2012	0.0651	0.002	0.02		SM3114C	SVL
			9/18/2013	0.0719	0.001	0.01		SM 3114C	SVL
			11/15/2013	0.0738	0.002	0.02		SM 3114C	SVL
			11/19/2014	0.068	0.002	0.02		SM 3114C	SVL
			9/22/2015	0.051	0.00062	0.002		EPA 6020A	SVL
			11/11/2015	0.0557	0.00011	0.002		EPA 6020A	SVL
			11/14/2016	0.058	0.00024	0.002		EPA 6020A	SVL
			11/13/2017	0.0244	0.0004	0.002		EPA 6020A	SVL
			10/29/2018	0.0372	0.0002	0.002		EPA 6020B	SVL
Alluvial GW: GW-22, 148-150 ft	**GW**	**Spring-Summer**							
Post-NTCRA Time Period									
GW-22, 148-150 ft	GW	Spring-Summer	6/25/2008	0.0125	0.0002	0.002		SM3114C	SVL
			6/2/2009	0.0416	0.001	0.01		SM3114C	SVL
			6/8/2010	0.0126	0.0002	0.002		SM3114C	SVL
			6/15/2011	0.0132	0.0002	0.002		SM3114C	SVL
			5/11/2012	0.0695	0.002	0.02		SM3114C	SVL
			5/21/2013	0.0828	0.002	0.02		SM 3114C	SVL
			6/11/2014	0.0671	0.002	0.02		SM 3114C	SVL
			8/26/2014	0.0514	0.002	0.02		SM 3114C	SVL
			5/11/2015	0.0812	0.00062	0.002		EPA 6020A	SVL
			7/28/2015	0.0362	0.00011	0.002		EPA 6020A	SVL
			5/16/2016	0.082	0.00024	0.002		EPA 6020A	SVL
			6/21/2017	0.0574	0.0004	0.002		EPA 6020A	SVL
			5/15/2018	0.0453	0.0002	0.002		EPA 6020B	SVL

Table D-1. Monitoring Data Used for 2018 Statistical Evaluations

Monitoring Location	Sample Media	Season	Date	Selenium, Total (mg/L)	MDL (mg/L)	PQL (mg/L)	Lab Qualifier[1]	Analytical Method	Laboratory
Lower Pole Canyon Creek: LP, LP-PD	**SW**	**Fall-Winter**							
Pre-NTCRA Time Period									
LP	SW	Fall-Winter	9/28/2004	0.895	0.03	0.1		SM3114C	SVL
			9/20/2005	0.94	0.02	0.2		SM3114C	SVL
Post-NTCRA Time Period									
LP-PD	SW	Fall-Winter	10/1/2008	0.0002	0.0002	0.002	U	SM3114C	SVL
			11/21/2009	0.00045	0.0002	0.002	B	SM3114C	SVL
			11/11/2010	0.00044	0.0002	0.002	B	SM3114C	SVL
			11/7/2011	0.00022	0.0002	0.002	B	SM3114C	SVL
			9/13/2012	0.0002	0.0002	0.002	U	SM3114C	SVL
			11/7/2012	0.0002	0.0002	0.002	U	SM3114C	SVL
			11/5/2013	0.0002	0.0002	0.002	U	SM 3114C	SVL
			11/19/2014	0.0002	0.0002	0.002	U	SM 3114C	SVL
			9/12/2015	0.0014	0.00062	0.002	J	EPA 6020A	SVL
			11/5/2015	0.00062	0.00062	0.002	U	EPA 6020A	SVL
			11/7/2016	0.0004	0.0002	0.005	J	EPA 6020A	SVL
			11/13/2017	0.0004	0.0004	0.002	U	EPA 6020A	SVL
			10/22/2018	0.0003	0.0002	0.002	J	EPA 6020B	SVL
Lower Pole Canyon Creek: LP, LP-PD	**SW**	**Spring-Summer**							
Pre-NTCRA Time Period									
LP	SW	Spring-Summer	5/15/2000	0.71	--	--	--	--	--
			6/22/2000	0.51	--	--	--	--	--
			5/15/2001	0.47	--	--	--	--	--
			5/15/2002	0.86	0.02	0.1		SM3500-Se C	--
			5/24/2003	0.58	0.02	0.1		SM3114C	ACZ
			6/4/2004	0.44	0.015	0.05		SM3114C	SVL
			7/20/2004	0.368	0.015	0.05		SM3114C	SVL
			5/18/2005	1.33	0.02	0.2		SM3114C	SVL
			5/21/2006	0.936	0.04	0.4		SM3114C	SVL
			5/22/2007	0.79	0.02	0.2		SM3114C	SVL
Post-NTCRA Time Period									
LP-PD	SW	Spring-Summer [a]	5/19/2008	0.0409	0.002	0.02		SM3114C	SVL
			6/2/2009	0.00041	0.0002	0.002	B	SM3114C	SVL
			6/8/2010	0.0005	0.0002	0.002	B	SM3114C	SVL
			6/14/2011	0.0364	0.0008	0.008		SM3114C	SVL
			8/28/2011	0.00047	0.0002	0.002	B	SM3114C	SVL
			4/25/2012	0.00045	0.0002	0.002	J	SM3114C	SVL
			5/11/2012	0.0002	0.0002	0.002	U	SM3114C	SVL
			5/30/2012	0.00023	0.0002	0.002	J	SM3114C	SVL
			7/23/2012	0.00026	0.0002	0.002	J	SM3114C	SVL
			8/30/2012	0.0002	0.0002	0.002	U	SM3114C	SVL
			5/21/2013	0.0002	0.0002	0.002	U	SM 3114C	SVL
			8/23/2013	0.0002	0.0002	0.002	U	SM 3114C	SVL
			5/20/2014	0.00031	0.0002	0.002	J	SM 3114C	SVL
			8/12/2014	0.00044	0.0002	0.002	J	SM 3114C	SVL
			5/8/2015	0.00062	0.00062	0.002	U	EPA 6020A	SVL
			5/18/2016	0.0002	0.0002	0.005	U	EPA 6020A	SVL
			5/15/2017	0.0004	0.0004	0.002	U	EPA 6020A	SVL
			5/18/2018	0.0009	0.0002	0.002	J	EPA 6020B	SVL

Table D-1. Monitoring Data Used for 2018 Statistical Evaluations

Monitoring Location	Sample Media	Season	Date	Selenium, Total (mg/L)	MDL (mg/L)	PQL (mg/L)	Lab Qualifier[1]	Analytical Method	Laboratory
Sage Creek: LSV-1	**SW**	**Fall-Winter**							
Pre-NTCRA Time Period									
LSV-1	SW	Fall-Winter	9/18/2001	0.0012	0.001	--	--	ICP-HG	--
			10/17/2002	0.001	0.001	0.005	U	SM3114C	ACZ
			10/27/2003	0.0013	0.0002	0.001		SM3114C	SVL
			10/17/2006	0.0012	0.0002	Not reported	B	SM3114C	SVL
Post-NTCRA Time Period									
LSV-1	SW	Fall-Winter	9/17/2008	0.0014	0.0002	0.002	B	SM3114C	SVL
			10/21/2009	0.00029	0.0002	0.002	B	SM3114C	SVL
			11/20/2009	0.00092	0.0002	0.002	B	SM3114C	SVL
			9/14/2010	0.00062	0.0002	0.002	B	SM3114C	SVL
			11/13/2010	0.00054	0.0002	0.002	B	SM3114C	SVL
			9/19/2011	0.00077	0.0002	0.002	B	SM 3114C	SVL
			11/10/2011	0.00049	0.0002	0.002	B	SM 3114C	SVL
			9/10/2012	0.00057	0.0002	0.002	J	SM 3114C	SVL
			11/15/2012	0.00065	0.0002	0.002	J	SM 3114C	SVL
			11/14/2013	0.00043	0.0002	0.002	J	SM 3114C	SVL
			11/17/2014	0.00072	0.0002	0.002	J	SM 3114C	SVL
			9/10/2015	0.00062	0.00062	0.002	U	EPA 6020A	SVL
			11/4/2015	0.00062	0.00062	0.002	U	EPA 6020A	SVL
			11/8/2016	0.00069	0.00024	0.002	J	EPA 6020A	SVL
			11/14/2017	0.0006	0.0004	0.002	J	EPA 6020A	SVL
			10/24/2018	0.0005	0.0002	0.002	J	EPA 6020B	SVL
Sage Creek: LSV-1	**SW**	**Spring-Summer**							
Pre-NTCRA Time Period									
LSV-1	SW	Spring-Summer	6/12/2001	0.001	0.001	--	--	ICP-HG	--
			5/16/2002	0.001	0.001	0.005	U	SM 3500-Se C	--
			5/22/2003	0.001	0.001	0.005	U	SM3114C	ACZ
			5/8/2004	0.002	0.0003	0.001		SM3114C	SVL
			7/21/2004	0.0036	0.0003	0.001		SM3114C	SVL
			5/21/2006	0.0336	0.001	0.01		SM3114C	SVL
			6/22/2006	0.0089	0.0002	0.002		SM3114C	SVL
Post-NTCRA Time Period									
LSV-1	SW	Spring-Summer [a]	5/31/2009	0.0019	0.0002	0.002	B	SM3114C	SVL
			6/6/2010	0.0015	0.0002	0.002	B	SM3114C	SVL
			6/1/2011	0.0018	0.0002	0.002	B	SM3114C	SVL
			6/14/2011	0.006	0.0002	0.002		SM3114C	SVL
			5/10/2012	0.0011	0.0002	0.002	J	SM3114C	SVL
			5/20/2013	0.0041	0.0002	0.002		SM 3114C	SVL
			8/23/2013	0.00056	0.0002	0.002	J	SM 3114C	SVL
			5/19/2014	0.0015	0.0002	0.002	J	SM 3114C	SVL
			8/13/2014	0.00057	0.0002	0.002	J	SM 3114C	SVL
			5/7/2015	0.0014	0.00062	0.002	J	EPA 6020A	SVL
			7/22/2015	0.00062	0.00062	0.002	U	EPA 6020A	SVL
			5/17/2016	0.0012	0.00024	0.002	J	EPA 6020A	SVL
			5/16/2017	0.0008	0.0004	0.002	J	EPA 6020A	SVL
			8/1/2017	0.001	0.0004	0.002	J	EPA 6020A	SVL
			5/16/2018	0.0012	0.0002	0.002	J	EPA 6020B	SVL
			8/8/2018	0.0007	0.0002	0.002	J	EPA 6020B	SVL

Table D-1. Monitoring Data Used for 2018 Statistical Evaluations

Monitoring Location	Sample Media	Season	Date	Selenium, Total (mg/L)	MDL (mg/L)	PQL (mg/L)	Lab Qualifier[1]	Analytical Method	Laboratory
North Fork Sage Creek: NSV-6	**SW**	**Fall-Winter**							
Pre-NTCRA Time Period									
NSV-6	SW	Fall-Winter	10/18/2002	0.001	0.001	0.005	U	SM3114C	ACZ
			10/28/2003	0.001	0.0002	0.001		SM3114C	SVL
			10/17/2006	0.0013	0.0002	Not reported	B	SM3114C	SVL
Post-NTCRA Time Period									
NSV-6	SW	Fall-Winter	9/16/2008	0.0016	0.0002	0.002	B	SM3114C	SVL
			10/21/2009	0.00066	0.0002	0.002	B	SM3114C	SVL
			9/14/2010	0.0012	0.0002	0.002	B	SM3114C	SVL
			11/11/2010	0.0014	0.0002	0.002	B	SM3114C	SVL
			9/20/2011	0.0014	0.0002	0.002	B	SM3114C	SVL
			9/13/2012	0.0011	0.0002	0.002	J	SM3114C	SVL
			11/15/2012	0.0013	0.0002	0.002	J	SM3114C	SVL
			9/18/2013	0.0012	0.0002	0.002	J	SM 3114C	SVL
			11/15/2013	0.00078	0.0002	0.002	J	SM 3114C	SVL
			9/12/2015	0.00062	0.00062	0.002	U	EPA 6020A	SVL
			11/5/2015	0.00062	0.00062	0.002	U	EPA 6020A	SVL
			11/8/2016	0.0011	0.00024	0.002	J	EPA 6020A	SVL
			11/13/2017	0.0004	0.0004	0.002	J	EPA 6020A	SVL
			10/22/2018	0.0004	0.0002	0.002	J	EPA 6020B	SVL
North Fork Sage Creek: NSV-6	**SW**	**Spring-Summer**							
Pre-NTCRA Time Period									
NSV-6	SW	Spring-Summer	5/16/2000	0.0079	--	--	--	ICP, Hydride	--
			5/15/2002	0.001	0.001	0.005	B	SM 3500-Se C	--
			5/24/2003	0.001	0.001	0.005	U	SM3114C	ACZ
			5/19/2004	0.0005	0.0003	0.001	B	SM3114C	SVL
			7/22/2004	0.00043	0.0003	0.001	B	SM3114C	SVL
Post-NTCRA Time Period									
NSV-6	SW	Spring-Summer [a]	6/19/2008	0.0067	0.0002	0.002		SM3114C	SVL
			6/2/2009	0.0061	0.0002	0.002		SM3114C	SVL
			6/7/2010	0.0116	0.0002	0.002		SM3114C	SVL
			6/2/2011	0.0054	0.0002	0.002		SM3114C	SVL
			6/14/2011	0.0437	0.001	0.01		SM3114C	SVL
			5/11/2012	0.0093	0.0002	0.002		SM3114C	SVL
			5/21/2013	0.0229	0.0004	0.004		SM 3114C	SVL
			5/20/2014	0.0104	0.0002	0.002		SM 3114C	SVL
			8/14/2014	0.0019	0.0002	0.002	J	SM 3114C	SVL
			5/8/2015	0.0045	0.00062	0.002		EPA 6020A	SVL
			7/21/2015	0.0015	0.00062	0.002	J	EPA 6020A	SVL
			5/18/2016	0.0057	0.00024	0.002		EPA 6020A	SVL
			5/15/2017	0.0022	0.0004	0.002		EPA 6020A	SVL
			5/18/2018	0.005	0.0002	0.002		EPA 6020B	SVL

Notes:

[1] Lab Qualifiers are assigned by the laboratory and have the following definitions: B or J = result value is less than the PQL but greater than the MDL; U = result is less than the MDL.

[a] Samples collected at monitoring locations GW-15, LP-PD, LSV-1, and NSV-6 from June 14 and 15, 2011 were collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the results associated with these samples are not considered representative of typical post-NTCRA conditions and, therefore, have been excluded from statistical comparison tests.

mg/L = milligram per liter
MDL = Method Detection Limit
PQL = Practical Quantitation Limit
SW = surface water
GW = ground water
NTCRA = Non-Time Critical Removal Action

Table D-3. Summary Statistics for 2018 Statistical Evalutations

Monitoring Location	Season	Time Period[1]	Number of Samples[2]	Mean Selenium Concentration (mg/L)	Standard Deviation	Data Distribution Type (Shapiro Wilk Test result)	Appropriate Statistical Tests for Trend[3]	Statistical Test for Trend Applied	Test Result (α = 0.10)	Conclusion Based on Statistical Evaluation (at desired level of confidence)
GW-15	Fall-Winter	Pre-NTCRA	6	0.627	0.259	Normal	T-test or Wilcoxon Rank-Sum	Wilcoxon Rank-Sum	Post-NTCRA concentrations < Pre-NTCRA	Selenium concentrations decreased after implementation of 2006 NTCRA.
		Post-NTCRA	20	0.165	0.109	Normal				
	Spring-Summer [5]	Pre-NTCRA	5	1.156	0.33	Normal	T-test or Wilcoxon Rank-Sum	Wilcoxon Rank-Sum	Post-NTCRA concentrations < Pre-NTCRA	Selenium concentrations decreased after implementation of 2006 NTCRA.
		Post-NTCRA	13	0.483	0.52	Lognormal				
GW-16	Fall-Winter	Pre-NTCRA	5	0.55	0.105	Normal	Wilcoxon Rank-Sum	Wilcoxon Rank-Sum	Post-NTCRA concentrations > Pre-NTCRA	Selenium concentrations increased after implementation of 2006 NTCRA.
		Post-NTCRA	20	0.81	0.133	No Discernible Distribution				
	Spring-Summer	Pre-NTCRA	5	0.72	0.139	Normal	T-test or Wilcoxon Rank-Sum	Wilcoxon Rank-Sum	Post-NTCRA concentrations > Pre-NTCRA	Selenium concentrations increased after implementation of 2006 NTCRA.
		Post-NTCRA	19	0.829	0.0712	Normal				
GW-22 (90 to 100 ft)	Fall-Winter	Pre-NTCRA	1	NA	NA	Not tested	Sen's Slope Test or Linear Regression	Sen's Slope Test	Sen's Test median slope is negative (concentrations decreasing), but additional data are needed to confirm, at the 90% confidence level, that concentrations are decreasing.	Need additional data to confirm decreasing trend at 90% conf. level.
		Post-NTCRA	18	0.121	0.0649	No Discernible Distribution				
	Spring-Summer	Pre-NTCRA	0	NA	NA	NA	Sen's Slope Test or Linear Regression	Sen's Slope Test	Sen's Test median slope is positive (concentrations increasing), but additional data are needed to confirm, at the 90% confidence level, that concentrations are increasing.	Need additional data to confirm increasing trend at 90% conf. level. Note that evaluation is based only on post-NTCRA data (pre-NTCRA data are not available).
		Post-NTCRA	14	0.111	0.0511	Normal				
GW-22 (148 to 150 ft)	Fall-Winter	Pre-NTCRA	0	NA	NA	NA	Sen's Slope Test or Linear Regression	Sen's Slope Test	Sen's Test median slope is positive (concentrations increasing), but additional data are needed to confirm, at the 90% confidence level, that concentrations are increasing.	Need additional data to confirm increasing trend at 90% conf. level. Note that evaluation is based only on post-NTCRA data (pre-NTCRA data are not available).
		Post-NTCRA	18	0.0462	0.0228	No Discernible Distribution				
	Spring-Summer	Pre-NTCRA	0	NA	NA	NA	Sen's Slope Test or Linear Regression	Sen's Slope Test	Sen's Test median slope is positive (concentrations increasing), but additional data are needed to confirm, at the 90% confidence level, that concentrations are increasing.	Need additional data to confirm increasing trend at 90% conf. level. Note that evaluation is based only on post-NTCRA data (pre-NTCRA data are not available).
		Post-NTCRA	13	0.0502	0.0262	Normal				

Table D-3. Summary Statistics for 2018 Statistical Evalutations

Monitoring Location	Season	Time Period[1]	Number of Samples[2]	Mean Selenium Concentration (mg/L)	Standard Deviation	Data Distribution Type (Shapiro Wilk Test result)	Appropriate Statistical Tests for Trend[3]	Statistical Test for Trend Applied	Test Result (α = 0.10)	Conclusion Based on Statistical Evaluation (at desired level of confidence)
LP	Fall-Winter	Pre-NTCRA	2	0.918	0.032	Not tested	Sen's Slope Test	Sen's Slope Test	Sen's Test median slope is negative (concentrations decreasing), but additional data are needed to confirm, at the 90% confidence level, that concentrations are decreasing.	Need additional data to confirm decreasing trend at 90% conf. level.
LP-PD		Post-NTCRA	13	0.000402	0.000328	No Discernible Distribution				
LP	Spring-Summer [5]	Pre-NTCRA	10	0.699	0.292	Normal	Wilcoxon Rank-Sum	Wilcoxon Rank-Sum	Post-NTCRA concentrations < Pre-NTCRA	Selenium concentrations decreased after implementation of 2006 NTCRA.
LP-PD		Post-NTCRA	17	0.00276	0.00983	No Discernible Distribution				
LSV-1 [4]	Fall-Winter	Pre-NTCRA	4	0.001175	0.000126	Not tested	Sen's Slope Test or Linear Regression	Sen's Slope Test	Sen's test median slope is negative; concentrations are decreasing.	Selenium concentrations decreasing over time.
		Post-NTCRA	16	0.000652	0.000246	Lognormal				
	Spring-Summer [5]	Pre-NTCRA	7	0.0073	0.012	Lognormal	T-test or Wilcoxon Rank-Sum	Wilcoxon Rank-Sum	Post-NTCRA concentrations < Pre-NTCRA	Selenium concentrations decreased after implementation of 2006 NTCRA.
		Post-NTCRA	15	0.00133	0.000880	Lognormal				
NSV-6 [4]	Fall-Winter	Pre-NTCRA	3	0.0011	0.0002	Not tested	Sen's Slope Test	Sen's Slope Test	Sen's test median slope is negative; concentrations are decreasing.	Selenium concentrations decreasing over time.
		Post-NTCRA	14	0.000984	0.000396	Normal				
	Spring-Summer [5]	Pre-NTCRA	5	0.0022	0.0032	Lognormal	T-test or Wilcoxon Rank-Sum	Wilcoxon Rank-Sum	Post-NTCRA concentrations > Pre-NTCRA	Selenium concentrations increased after implementation of 2006 NTCRA.
		Post-NTCRA	13	0.00717	0.00567	Lognormal				

Notes:
[1] Pre Non-Time-Critical Removal Action (NTCRA) data collected from 1/1/2000 through 9/30/2007. Post-NTCRA data collected from 10/1/2007 through 10/29/2018.
[2] Selenium concentration data used in statistical evaluations are provided in Appendix D, Table D-1.
[3] Refer to Appendix D text for description of statistical test methods.
[4] Note that some of the source data for LP-PD, LSV-1, and NSV-6 are estimated values due to selenium concentrations less than the Practical Quantitation Limit (PQL). Therefore, the results of the statistical tests at these locations are less certain than for locations with values reported above the PQL.
[5] Samples collected at monitoring locations GW-15, LP-PD, LSV-1, and NSV-6 from June 14 and 15, 2011 were collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the results associated with these samples are not considered representative of typical post-NTCRA conditions and, therefore, have been excluded from statistical comparison tests.

Table D-5. Selenium Mass Load Data for Lower Pole Canyon Creek (LP/LP-PD)

Season	Monitoring Location	Date	Total Selenium (mg/L)	Flow (cfs)	Selenium Mass Load (lbs/day)
Pre-NTCRA Time Period					
Fall-Winter	LP	9/28/2004	0.895	0.011	0.053
		9/20/2005	0.94	0.004	0.020
Post-NTCRA Time Period					
Fall-Winter	LP-PD	11/21/2009	0.00045 B	0.143	<0.001
		11/11/2010	0.00044 B	0.200	<0.001
		11/7/2011	0.00022 B	0.083	<0.001
		11/7/2012	0.0002 U	0.106	<0.001
		11/5/2013	0.0002 U	0.086	<0.001
		11/19/2014	0.0002 U	0.086	<0.001
		9/12/2015	0.0014 J	0.169	0.001
		11/5/2015	0.00062 U	0.073	<0.001
		11/7/2016	0.0004 J	0.160	<0.001
		11/13/2017	0.0004 U	0.095	<0.001
		10/22/2018	0.0003 J	0.113	<0.001
Pre-NTCRA Time Period					
Spring-Summer	LP	6/22/2000	0.51	0.550	1.51
		5/15/2002	0.86	2.019	9.37
		5/24/2003	0.58	1.760	5.51
		6/4/2004	0.44	0.900	2.14
		7/20/2004	0.368	0.190	0.377
		5/18/2005	1.33	4.492	32.2
		5/21/2006	0.936	4.969	25.1
		5/22/2007	0.79	0.682	2.91
Post-NTCRA Time Period					
Spring-Summer	LP-PD	5/19/2008	0.0409	7.371	1.63
		6/2/2009	0.00041 B	3.583	0.008
		6/8/2010	0.0005 B	2.033	0.005
		5/11/2012	0.0002 U	1.171	0.001
		8/30/2012	0.0002 U	0.148	<0.001
		5/21/2013	0.0002 U	2.490	0.003
		8/23/2013	0.0002 U	0.148	0.010
		5/20/2014	0.00031 J	5.740	<0.001
		8/12/2014	0.00044 J	0.380	<0.001
		5/8/2015	0.00062 U	3.014	0.010
		5/18/2016	0.0002 U	2.500	0.003
		5/15/2017	0.0004 U	9.420	0.020
		5/18/2018	0.0009 J	3.623	0.018

Note: Mass load values are provided only where paired Total Selenium and Flow data are available.

B : Detected at a value between Method Detection Limit and Practical Quantification Limit

J : Estimated value

U : Not detected above the Method Detection Limit

mg/L = milligrams per liter   cfs = cubic feet per second   lbs/day = pounds per day

Table D-6. Selenium Mass Load Data for Lower Sage Valley (LSV-1)

Season	Monitoring Location	Date	Total Selenium (mg/L)	Flow (cfs)	Selenium Mass Load (lbs/day)
Pre-NTCRA Time Period					
Fall-Winter	LSV-1	10/17/2002	0.001 U	0.25	0.001
		10/27/2003	0.0013	0.60	0.004
		10/17/2006	0.0012 B	2.57	0.017
Post-NTCRA Time Period					
Fall-Winter	LSV-1	9/17/2008	0.0014 B	4.06	0.031
		11/20/2009	0.00092 B	2.79	0.014
		9/14/2010	0.00062 B	1.46	0.005
		11/13/2010	0.00054 B	2.87	0.008
		11/10/2011	0.00049 B	4.64	0.012
		11/15/2012	0.00065 J	0.87	0.003
		11/14/2013	0.00043 J	1.60	0.004
		11/17/2014	0.00072 J	2.19	0.008
		9/10/2015	0.00062 U	4.08	0.014
		11/4/2015	0.00062 U	2.92	0.010
		11/8/2016	0.00069 J	3.58	0.013
		11/14/2017	0.0006 J	4.43	0.014
		10/24/2018	0.0005 J	3.09	0.008
Pre-NTCRA Time Period					
Spring-Summer	LSV-1	5/16/2002	0.001 U	1.88	0.010
		5/22/2003	0.001 U	0.82	0.004
		5/8/2004	0.002 J-	1.6	0.017
		7/21/2004	0.0036	1.4	0.027
Post-NTCRA Time Period					
Spring-Summer	LSV-1 [a]	5/31/2009	0.0019 B	22.27	0.228
		6/6/2010	0.0015 B U	16.41	0.133
		6/14/2011	0.006	54.67	1.769[a]
		5/10/2012	0.0011 J	10.86	0.064
		5/20/2013	0.0041	11.41	0.252
		5/19/2014	0.0015 J	22.17	0.179
		8/13/2014	0.00057 J	1.59	0.005
		5/7/2015	0.0014 J	19.39	0.146
		7/22/2015	0.00062 U	8.46	0.028
		5/17/2016	0.0012 J	23.45	0.152
		5/16/2017	0.0008 J	43.79	0.189
		8/1/2017	0.001 J	6.24	0.034
		5/16/2018	0.0012 J	28.73	0.186
		8/8/2018	0.0007 J	6.04	0.023

Note: Mass load values are provided only where paired Total Selenium and Flow data are available.

[a] The June 14, 2011 sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result associated with this sample is not considered representative of typical post-NTRCRA conditions and the result has been excluded from statistical comparison tests performed for LSV-6 (spring-summer season).

B : Detected at a value between Method Detection Limit and Practical Quantification Limit

J : Estimated value J-: Estimated value potentially biased low

U : Not detected above the Method Detection Limit; value reported is the Method Detection Limit

mg/L = milligrams per liter cfs = cubic feet per second lbs/day = pounds per day

Table D-7. Selenium Mass Load Data for North Sage Valley (NSV-6)

Season	Monitoring Location	Date	Total Selenium (mg/L)	Flow (cfs)	Selenium Mass Load (lbs/day)
Pre-NTCRA Time Period					
Fall-Winter	NSV-6	10/18/2002	0.001 U	0.05	<0.001
		10/28/2003	0.001 J-	0.15	<0.001
		10/17/2006	0.0013 B	0.93	0.007
Post-NTCRA Time Period					
Fall-Winter	NSV-6	9/16/2008	0.0016 B	0.46	0.004
		9/14/2010	0.0012 B	0.19	0.001
		11/11/2010	0.0014 B	0.39	0.003
		9/12/2015	0.00062 U	0.14	<0.001
		11/5/2015	0.00062 U	0.29	<0.001
		11/8/2016	0.0011 J	0.56	0.003
		11/13/2017	0.0004 J	0.35	0.001
		10/22/2018	0.0004 J	0.20	0.00043
Pre-NTCRA Time Period					
Spring-Summer	NSV-6	5/15/2002	0.001 B	0.82	0.004
		5/24/2003	0.001 U	0.05	<0.001
		7/22/2004	0.00043 B	0.27	<0.001
Post-NTCRA Time Period					
Spring-Summer	NSV-6 [a]	6/19/2008	0.0067	2.77	0.100
		6/2/2009	0.0061	7.44	0.245
		6/7/2010	0.0116	1.54	0.096
		6/14/2011	0.0437	7.19	1.696[a]
		5/11/2012	0.0093	1.18	0.059
		5/21/2013	0.0229	1.74	0.215
		5/20/2014	0.0104	1.77	0.099
		8/14/2014	0.0019 J	0.29	0.003
		7/21/2015	0.0015 J	0.56	0.005
		5/18/2016	0.0057	3.72	0.114
		5/15/2017	0.0022	7.57	0.090
		5/18/2018	0.005	3.78	0.102

Note: Mass load values are provided only where paired Total Selenium and Flow data are available.

[a] The June 14, 2011 sample was collected at a time when the creek bypass pipeline was not functioning as designed; therefore, the result associated with this sample is not considered representative of typical post-NTRCRA conditions and the result has been excluded from statistical comparison tests performed for NSV-6 (spring-summer season).

Definitions for lab and validation qualifiers:

B : Detected at a value between Method Detection Limit and Practical Quantification Limit

J : Estimated value — J-: Estimated value potentially biased low

U : Not detected above the Method Detection Limit

mg/L = milligrams per liter — cfs = cubic feet per second — lbs/day = pounds per day

APPENDIX E

Water-Balance and Mass-Balance Comparison

APPENDIX E

WATER-BALANCE AND MASS-BALANCE COMPARISON

The annual water-balance and mass-balance comparison is based on modeled water inflows to and outflows from the Pole Canyon ODA. The mass-balance is based on the water-balance model, but also considers selenium concentration data to compute the total annual selenium load (pounds per year) released from the ODA to the environment along the three primary transport pathways: lower Pole Canyon Creek flow (surface water), alluvial groundwater flow, and Wells Formation groundwater flow.

The water-balance and selenium mass-balance models described in the following sections are based on previous models developed for the Pole Canyon ODA. The first model was created in 2004 and 2005 for the Site Investigation Report (NewFields 2005), and used data collected in 2004 to create a month-by-month accounting of water and selenium transport from the Pole Canyon ODA. The water-balance and mass-balance models were revised and updated for the Site-wide water-balance model (NewFields 2009a), and further refined for the RI (Formation 2014).

The inputs and assumptions for the water-balance and mass-balance models developed to evaluate 2018 conditions are described in the following sections. The approach used for 2018 is consistent with the previous modeling work completed for the Site; except for refinements of infiltration estimates (updated methods for creating air temperature and precipitation data for model input).

E.1 Water-Balance Inflows

Before the 2006 NTCRA was constructed, there were three primary inflow pathways for water to enter the Pole Canyon ODA:

- Upper Pole Canyon Creek flow
- Direct infiltration
- Run-on from the 95-acre upslope area due north of the ODA

In 2007, two components of the 2006 NTCRA were constructed, the creek bypass pipeline and the infiltration basin, which eliminated the inflow from upper Pole Canyon. Therefore, after 2007 there were two primary pathways for water to enter the Pole Canyon ODA:

- Direct infiltration
- Run-on from the 95-acre upslope area due north of the ODA

In 2008, the run-on control channel was constructed as part of the 2006 NTCRA to eliminate run-on from the 95-acre upslope area immediately north of the ODA (Figure E-1). Thus, direct infiltration was the only remaining primary pathway for water to enter the Pole Canyon ODA after completion of the 2006 NTCRA.

In 2010, the south end of Panel A was reclaimed and runoff from this area (Figure E-1) was directed south and into a ditch adjacent to the haul road that crossed the top surface of the Pole Canyon ODA. Run-on from this Panel A storm water collection ditch represented an additional inflow to the Pole Canyon ODA from 2011 through 2014. In 2015, as part of construction of the 2013 NTCRA, the run-on from Panel A was redirected to an infiltration basin located on the west side of the Pole Canyon ODA. This new configuration directs the relatively clean storm water into the Wells Formation without contact with the ODA material. Beginning in 2016, the Panel A storm water was eliminated as an inflow for the “with NTCRAs” scenario.

The native materials in Pole Canyon are thin colluvial deposits overlying highly permeable, unsaturated, Wells Formation sandstone/limestone. The depth to groundwater in the Wells Formation is more than 300 feet below the bottom of the Pole Canyon ODA. Therefore, the Wells Formation is not a source of inflow water to the ODA. Due to the geology of Pole Canyon, lateral inflows from native material to the Pole Canyon ODA are considered to be negligible.

Figure E-2 illustrates the conceptual water-balance model developed for both the “with NTCRAs” and “without NTCRAs” scenarios and identifies each source of water inflow to the Pole Canyon ODA and each pathway for water outflow from the Pole Canyon ODA under these scenarios.

<u>2018 Water-Balance Model Inflow Assumptions</u>

Each annual water-balance model uses data collected during the 12-month period from December 1 through November 30; this approach accounts for the effects of snow that accumulates in December but does not melt for several weeks or months.

Based on the above narrative, the “without NTCRAs” water-balance assumes no actions at the Pole Canyon ODA but includes the reclamation activities at Panel A to provide a theoretical baseline scenario. The total inflow for the “without NTCRAs” water balance is described by the following:

Upper Pole Canyon Creek Flow	+	Run-on from Panel A Storm Water Collection Ditch	+	Direct Infiltration	+	Run-on from Upslope Area Due North of ODA	=	Total Inflow

The 2018 “with NTCRAs” water-balance model, assumes that the combination of the 2006 NTCRA and the 2013 NTCRA eliminates all inflows to the ODA except for direct infiltration which is now decreased due to construction of the Dinwoody/Chert cover system. Therefore, the “with NTCRAs” total inflow is equal to the annual volume of direct infiltration.

The methods and specific assumptions used to estimate the annual inflow associated with each source of water to the ODA are discussed in the following sections.

E.1.1 Upper Pole Canyon Creek Flow

The upper Pole Canyon Creek watershed covers an area of 1,102 acres upstream of the ODA (Figure E-1). Runoff from the watershed collects in Pole Canyon Creek and flows toward the ODA. Before the 2006 NTCRA was constructed, the creek entered the ODA where the native stream bed intercepted the base of the placed overburden material at the upper end. The inlet to the creek bypass pipeline installed as part of the 2006 NTCRA is located upstream from the ODA, capturing the creek flow and runoff from the upper portion of the watershed, and conveying it around the ODA. Runoff generated in the portion of the watershed between the pipeline inlet and the ODA flows overland to the infiltration basin where it is directed into the underlying Wells Formation bedrock without contacting ODA material. Based on routine observations and inspections of the 2006 NTCRA components, along with a geophysical study (Willowstick Technologies 2012) performed after construction of the 2006 NTCRA, these features are operating as designed.

The annual volume of water directed to the bypass pipeline in 2018 was computed using flow data collected at the pipeline inlet weir (UP-PD). It should be noted that the volume of water directed to the bypass pipeline was underestimated in 2018. The UP-PD transducer was damaged due to ice buildup over the winter and flow data for water directed into the pipeline is not available until the transducer could be replaced in May. This underestimates the amount of water flowing through the ODA in the “without-NTCRA” scenario and provides a conservative estimate of NTCRA effectiveness. The total 2018 annual runoff directed to the infiltration basin was estimated using flow measurements at the flume installed upgradient/upstream of the infiltration basin at station UP-IN and a modeled estimate of annual runoff reporting directly to the infiltration basin immediately downstream of the UP-IN monitoring station.

<u>Water-Balance Model Assumptions:</u>

- Runoff from the uppermost 615 acres of the watershed is diverted around the ODA through the bypass pipeline.

- Runoff from the remaining 487 acres, between the pipeline inlet and the infiltration basin, is directed to the infiltration basin where it infiltrates to the underlying Wells Formation.

- Runoff from 277 acres flows directly to the infiltration basin without passing through the UP-IN flume. The annual volume of runoff from this area is estimated using the HELP3 model for undisturbed, natural ground.

- Gaining conditions from shallow groundwater to Pole Canyon Creek are considered negligible due to the native geology of the canyon.

- The “without NTCRAs” scenario assumes runoff from the entire 1,102-acre watershed enters the Pole Canyon ODA.

- The “with NTCRAs” scenario assumes zero runoff from the 1,102-acre watershed enters the Pole Canyon ODA.

E.1.2 Direct Infiltration

The direct infiltration pathway utilizes a portion of the annual precipitation that falls onto the Pole Canyon ODA and infiltrates below the evapotranspiration (ET) zone. The fraction of precipitation that infiltrates beyond the ET zone is dependent on many factors including daily meteorological conditions, soil properties, vegetation properties, slope, and aspect.

The annual infiltration volume is estimated using the HELP3 model (Schroeder et al. 1994). The HELP3 model has been used in previous investigations to estimate infiltration rates at the Smoky Canyon Mine, including the initial Pole Canyon ODA water-balance and mass-balance models (NewFields 2004), the Site Investigation (NewFields 2005), the RI (Formation 2014), the Panels B & C Supplemental Environmental Impact Statement (SEIS) (BLM and USFS 2002), and the Panels F & G Environmental Impact Statement (EIS) (BLM and USFS 2007; Knight Piésold 2005). Many of the HELP3 model inputs adopted for the annual water-balance model are based on previous modeling activities (refer to Attachment E-1 for HELP3 model input and output). As noted above, refinements to the water-balance and mass-balance modeling have been incorporated into the infiltration estimates and use information available from other sources including site-specific data collected for the Deep Dinwoody cover lysimeter study at Panel E.

Water-Balance Model Assumptions:

- The area of the Pole Canyon ODA is 120 acres, which is graded to allow runoff off from the new Dinwoody/Chert cover system.

- The vegetation growing season extends from the end of May through the end of August.

- The soil curve number of 86 was used for consistency with the RI (Formation 2014).

- The “without NTCRAs” scenario assumes direct vegetation of overburden material with the vegetation in poor condition.

- The “with NTCRAs” scenario assumes a cover of three feet of Dinwoody Formation material over two feet of chert with the vegetation in fair condition.

E.1.3 Run-On from Upslope Area Due North of the ODA

Run-on from the upslope area includes runoff from the approximately 95 acres, north of the Pole Canyon ODA, that flows toward the ODA during spring snowmelt and storm events (Figure E-1). Run-on from this upslope area was modeled as undisturbed natural ground using HELP3 (refer to Attachment E-1 for HELP3 model output).

<u>Water-Balance Model Assumptions:</u>

- The "without NTCRAs" scenario assumes all estimated run-on from the upslope area, north of the ODA, enters the Pole Canyon ODA.

- The "with NTCRAs" scenario assumes the run-on control channel eliminates the inflow pathway from the 95-acre upslope area by intercepting and redirecting run-on around the Pole Canyon ODA.

E.1.4 Run-On from Panel A Storm Water Collection Ditch Crossing ODA

Prior to construction of the 2013 NTCRA Dinwoody/Chert cover system in 2015, runoff from the reclaimed area of Panel A was directed into a storm water collection ditch adjacent to the haul road that crossed the top surface of the Pole Canyon ODA. Depending on the magnitude of flow, some or all of this water infiltrated into the Pole Canyon ODA. The geophysical study, performed in June 2012 (Willowstick Technologies 2012), showed areas where water in the Panel A ditch infiltrated into the ODA. Observations by Mine personnel indicated that there was typically significant flow lost as the runoff flowed across the Pole Canyon ODA. The new (2013 NTCRA) configuration of the run-on controls directs the relatively clean storm water from Panel A into the Wells Formation without contacting ODA material.

<u>Water-Balance Model Assumptions:</u>

- The area of Panel A contributing runoff to the collection ditch is 105 acres.

- The Panel A reclamation consisted of regrading overburden material and placing a six-inch topsoil cover (this cover configuration was used to model runoff from Panel A in HELP3, Appendix E).

- The "without NTCRAs" scenario assumes approximately 75 percent of the runoff from Panel A infiltrates into the Pole Canyon ODA.

- The "with NTCRAs" scenario assumes the new run-on controls eliminate the Panel A storm water inflow (and infiltration) to the ODA.

E.2 Water-Balance Outflows

The total annual outflow volume equals the total estimated annual inflow to the Pole Canyon ODA, as discussed in Section E.1. This approach assumes no change to net storage of water in the Pole Canyon ODA over the 12-month period from December 1, 2017 through November 30, 2018.

Water can exit the Pole Canyon ODA via three primary flow pathways:

- Direct discharge to surface water in lower Pole Canyon
- Vertical infiltration to the alluvial groundwater beneath the ODA
- Vertical infiltration to the Wells Formation groundwater beneath the ODA.

The water-balance model requires estimation of the annual outflow for each pathway. Water leaving the Pole Canyon ODA via the surface water pathway to lower Pole Canyon Creek is measured directly at LP-1. The volume of water leaving via the groundwater pathways is estimated.

<u>Water-Balance Model Assumptions:</u>

- Both water-balance scenarios assume 37 percent of total inflow volume infiltrates to the Wells Formation via the groundwater pathway.
- The “without NTCRAs” scenario calculates the volume of water leaving the ODA via the alluvial groundwater and the surface water pathway using the assumptions developed for the Final RI Report (Formation 2014):
  - Flow to the alluvial groundwater system is an estimated maximum annual volume of 65 acre-feet, limited by the physical dimensions of the alluvium (i.e., saturated thickness and width) and hydraulic characteristics (i.e., gradient and hydraulic conductivity) at the toe of the Pole Canyon ODA.
  - The remainder of the inflow volume (after subtracting water to the Wells Formation and the alluvium) is assumed to leave the ODA via the surface water flow pathway to lower Pole Canyon Creek.
- The “with NTCRAs” scenario calculates the annual outflows from the Pole Canyon ODA with the following assumptions:
  - The surface water flow pathway is calculated using the continuous flow data collected at LP-1.

- The remainder of the inflow volume (after removing water to the Wells Formation and surface water) is assumed to leave the ODA via the alluvial groundwater flow pathway.

E.3 Mass-Balance Description

The selenium mass-balance model is based on the water-balance model described above, but also includes selenium mass loading estimates for each of the three primary outflow pathways from the Pole Canyon ODA (i.e., surface water via lower Pole Canyon Creek, alluvial groundwater, and Wells Formation groundwater). The selenium mass load associated with each pathway is based on the annual water flux estimated using the water balance and measured or estimated selenium concentrations.

The selenium concentration in water leaving the Pole Canyon ODA as surface water can be measured directly at LP-1. Figure E-3 shows the selenium concentrations measured at LP, LP-1, and LP-PD from 2003 through 2018. Although the selenium concentrations measured at LP-1 have increased, the magnitude and the duration of flow at LP-1 have generally decreased since the 2006 NTCRA was implemented.

A time-varying selenium source concentration function was developed using empirical data from column leach test results conducted for the Panels F & G EIS modeling effort (BLM and USFS 2007). The source concentration function was used to calculate the mass of selenium leached from overburden by water moving through the material via the direct infiltration pathway. Over time, the mass available for transport from the overburden attenuates and consequently the theoretical groundwater concentrations decrease each year. This approach to estimate the average annual selenium concentration in groundwater outflows is consistent with the Final RI Report (Formation 2014).

<u>Mass-Balance Model Assumptions:</u>

- The average selenium concentration measured at LP-1 was 1.1 mg/L between 2003 and 2007. This is the assumed average annual selenium concentration in outflow surface water for the “without NTCRAs” scenario.

- The estimated average annual selenium concentration in outflow surface water for the “with NTCRAs” scenario is typically based on a flow-weighted average concentration from samples collected during the spring (April through June). For 2018, the annual average selenium concentration for surface water flowing from the ODA is the same as the concentration for the spring 2018 LP-1 sample (4.91 mg/L). This is the time of the year when the vast majority of flow occurs.

- The empirically based source concentration function assumes that the overburden was placed in 1985. Using the function, the selenium source concentration in groundwater for 2018 is 0.44 mg/L for both “with NTCRAs” and “without NTCRAs” scenarios.

E.4 References

Bureau of Land Management and USDA Forest Service (BLM and USFS). 2002. Final Supplemental Environmental Impact Statement: Smoky Canyon Mine, Panels B & C. US Department of Interior, Bureau of Land Management, Pocatello Field Office, Pocatello, Idaho. US Department of Agriculture, Forest Service, Caribou National Forest. April.

BLM and USFS. 2007. Smoky Canyon Mine Panels F & G, Final Environmental Impact Statement. Prepared by JBR Environmental Consultants, Inc., Sandy, UT. Caribou-Targhee National Forest and BLM Idaho State Office. October.

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NewFields. 2005. Site Investigation Report, Smoky Canyon Mine. Prepared for J.R. Simplot Company, Pocatello, ID. July.

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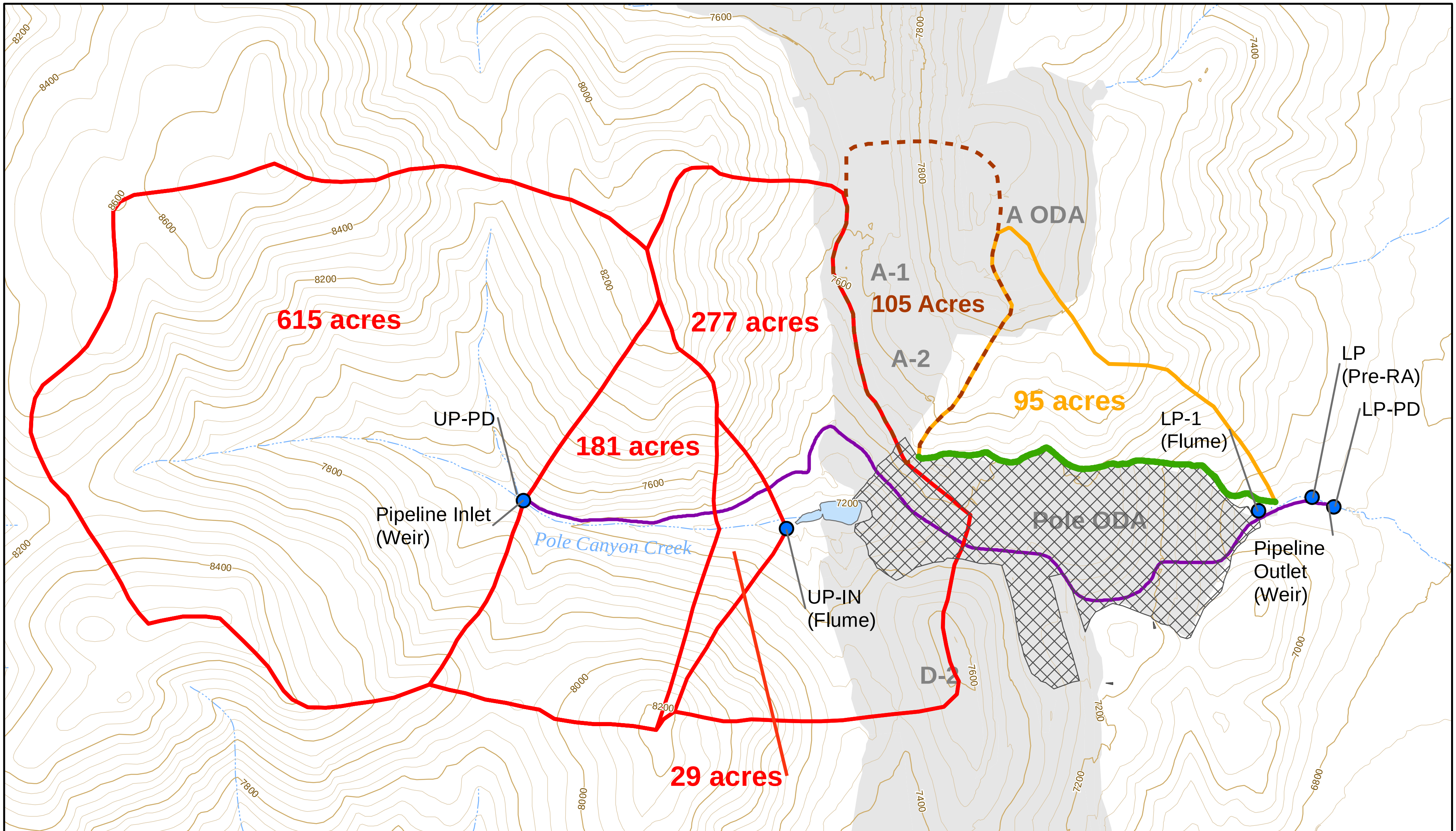
Schroeder, P.R., Dozier, T.S., Sjostrom, J.W., and McEnroe, B.M. (Schroeder et al.) 1994. Hydrologic Evaluation of Landfill Performance (HELP) Model. September 1994. U.S. Army Corp of Engineers, Waterways Experiment Station (WES). Version 3.07.

Willowstick Technologies, LLC. 2012. Willowstick Investigation of the Smoky Canyon Mine Pole Canyon ODA. Prepared for J.R. Simplot Company. October.

FIGURES

S:\GIS\ARCPRJ2\010109\PLT\EFFECTIVENESSMONPLAN\2018ANNUALRPT\FIGE_1_POLEFLOWLOCS.MXD



Legend

Flume and Weir Locations	Bypass Pipeline (2006 NTCRA)
Drainage Area for Runoff from Panel A Reclaimed Area	Run-on Control Channel (2006 NTCRA)
Pole Canyon ODA 2013 NTCRA Cover Area	Sedimentation/Infiltration Basin (2006 NTCRA)
Upper Pole Canyon Creek Watershed	Mine Disturbance Areas
Run-on Control Channel Watershed	**NTCRA = Non-Time-Critical Removal Action**

N

0 1,000 2,000
Feet

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SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

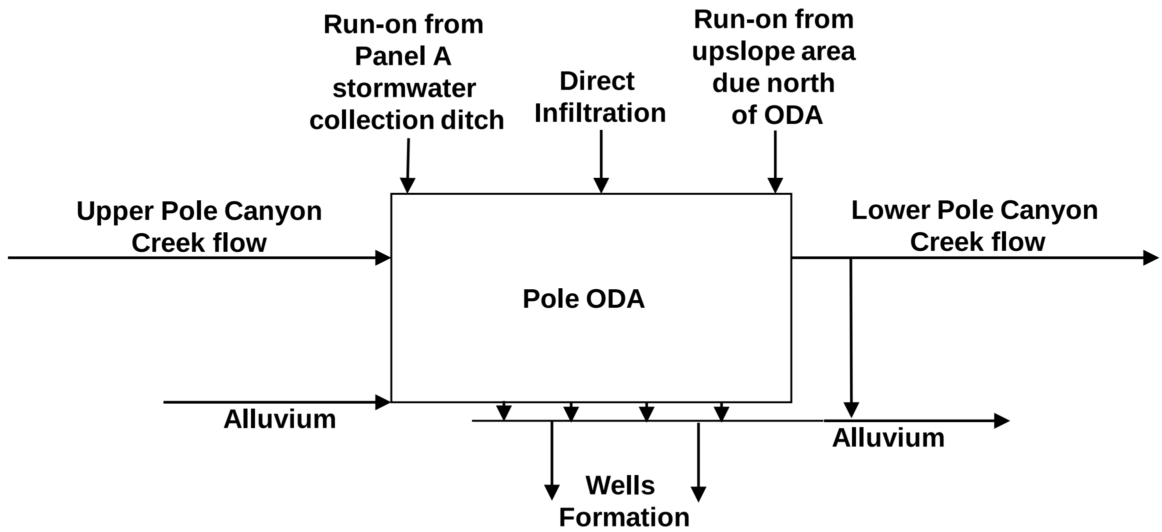
FIGURE E-1

UPPER POLE CANYON CREEK WATERSHED AND 2006 NTCRA COMPONENTS

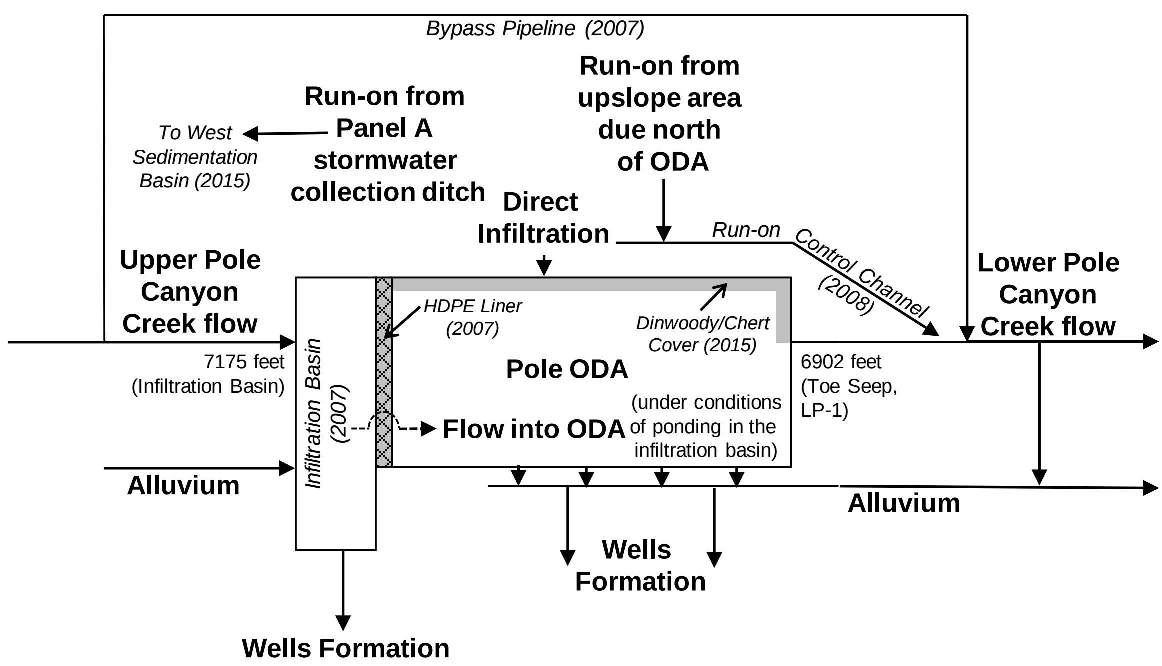
DATE: JUL 25, 2019
BY: CRL FOR: ACK

FORMATION ENVIRONMENTAL

Without Non-Time-Critical Removal Actions



With Non-Time-Critical Removal Actions



Notes:

1. The "Without Non-Time-Critical Removal Actions" model represents the model inputs/outputs before the Removal Actions were constructed or if the Removal Actions had not been constructed (i.e., the "no action" scenario).
2. The "With Non-Time-Critical Removal Actions" model represents the model inputs/outputs after the Removal Actions were constructed (i.e., the "as-built" scenario).
3. The Non-Time-Critical Removal Action components are in italics with the year of construction in parentheses.
4. There is an impermeable barrier between the infiltration basin and the Pole Canyon ODA, which greatly limits surface or alluvial water in the upper Pole Canyon Creek drainage from entering the ODA.

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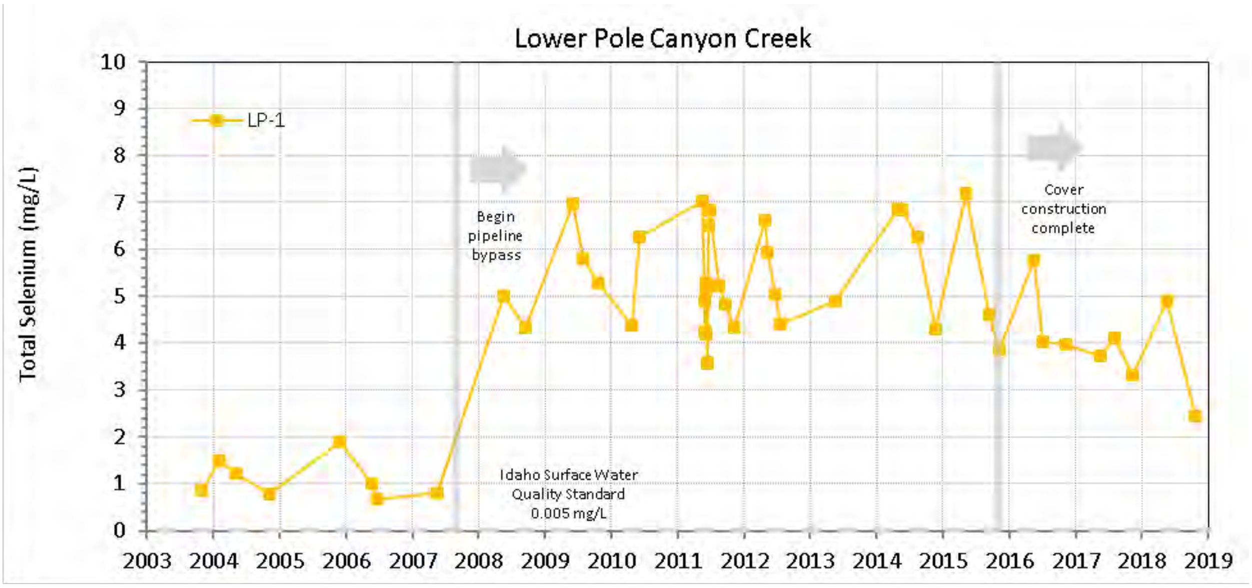
FIGURE E-2

WATER BALANCE CONCEPTUAL MODEL

DATE: JULY 2019

BY: LJM | FOR: ACK

FORMATION ENVIRONMENTAL



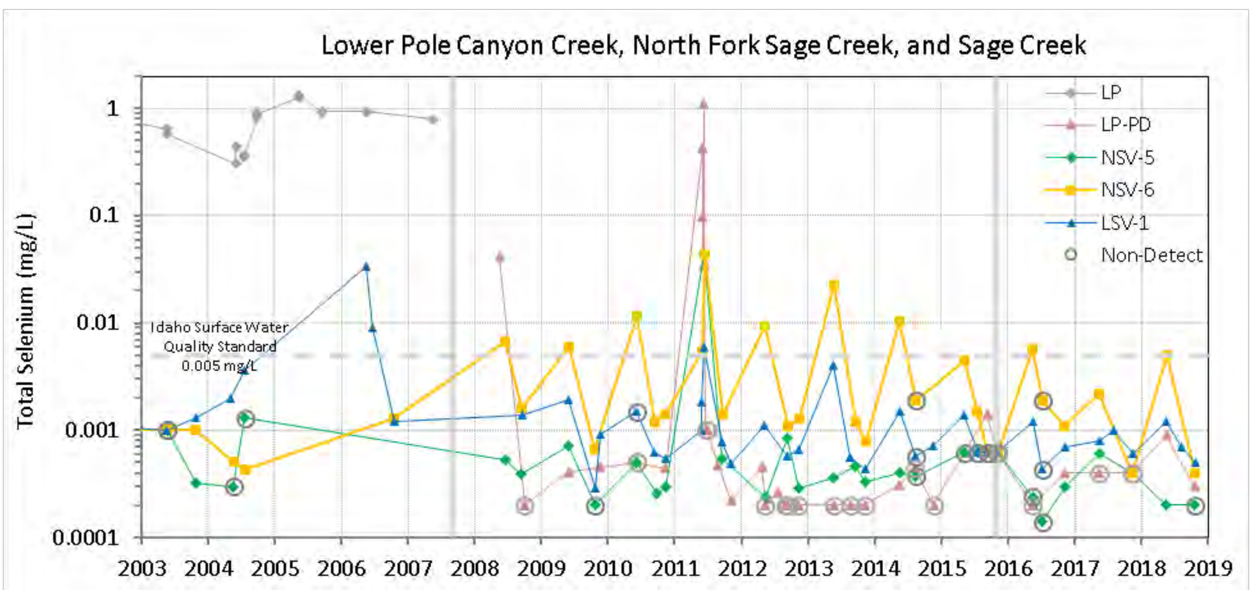


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FIGURE E-3

TOTAL SELENIUM CONCENTRATIONS IN LOWER POLE CANYON CREEK, NORTH FORK SAGE CREEK, AND SAGE CREEK

DATE: JULY 2019
BY: LJM
FOR: ACK

FORMATION ENVIRONMENTAL

ATTACHMENT E-1

HELP3 Model Output

Pole Canyon ODA 2015 - 2018

Exposed Overburden Pile

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************
```

```
PRECIPITATION DATA FILE:    c:\PREC8418.D4
TEMPERATURE DATA FILE:      c:\TEMP8418.D7
SOLAR RADIATION DATA FILE:  c:\SOL8418.D13
EVAPOTRANSPIRATION DATA:    c:\EOPEVAPO.D11
SOIL AND DESIGN DATA FILE:  c:\EOPSOIL.D10
OUTPUT DATA FILE:           C:\EOPOUT18.OUT
```

```
TIME:  11: 4     DATE:   4/25/2019
```

```
******************************************************************************

     TITLE:  Exposed Overburden Pile

******************************************************************************
```

```
     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.
```

```
                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
```



```
                       MATERIAL TEXTURE NUMBER   0
   THICKNESS                  =     24.00   INCHES
   POROSITY                   =      0.3650 VOL/VOL
   FIELD CAPACITY             =      0.2390 VOL/VOL
   WILTING POINT              =      0.1020 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.1451 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.260000005000E-01 CM/SEC
```

```
           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

 SCS RUNOFF CURVE NUMBER            =     86.00
 FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
 EVAPORATIVE ZONE DEPTH             =     24.0    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE   =      3.483  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE  =      8.760  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.448  INCHES
 INITIAL SNOW WATER                 =      3.699  INCHES
 INITIAL WATER IN LAYER MATERIALS    =      3.483  INCHES
 TOTAL INITIAL WATER                =      7.182  INCHES
 TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

```
            EVAPOTRANSPIRATION AND WEATHER DATA
            ----------------------------------

  NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
           POCATELLO            IDAHO

     STATION LATITUDE                       =  42.68 DEGREES
     MAXIMUM LEAF AREA INDEX                =   1.50
     START OF GROWING SEASON (JULIAN DATE)  =    150
     END OF GROWING SEASON (JULIAN DATE)    =    240
     EVAPORATIVE ZONE DEPTH                 =  24.0  INCHES
     AVERAGE ANNUAL WIND SPEED              =   3.60 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  69.70 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  54.70 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  45.10 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  67.70 %
```

NOTE: PRECIPITATION DATA FOR SMOKY CANYON MINE IDAHO

WAS ENTERED BY THE USER.

NOTE: TEMPERATURE DATA FOR SMOKY CANYON MINE IDAHO
WAS ENTERED BY THE USER.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO
AND STATION LATITUDE = 42.68 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2015

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.77	1.99	1.24	2.21	5.96	1.36
	1.39	1.37	1.90	1.07	2.88	3.28
RUNOFF	0.785	0.955	0.067	0.000	0.001	0.000
	0.000	0.000	0.000	0.000	0.000	0.272
EVAPOTRANSPIRATION	0.142	0.522	0.902	2.597	3.977	2.129
	1.453	1.388	1.538	0.909	0.593	0.321
PERCOLATION/LEAKAGE THROUGH	0.0000	2.4670	0.1250	0.0283	1.4707	0.0428
LAYER 1	0.0188	0.0047	0.1772	0.0150	1.3841	0.0000

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ANNUAL TOTALS FOR YEAR 2015

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.42	95904.547	100.00
RUNOFF	2.080	7550.771	7.87
EVAPOTRANSPIRATION	16.473	59796.281	62.35
PERC./LEAKAGE THROUGH LAYER 1	5.733569	20812.855	21.70
CHANGE IN WATER STORAGE	2.134	7744.687	8.08
SOIL WATER AT START OF YEAR	3.528	12806.978	
SOIL WATER AT END OF YEAR	4.123	14966.931	
SNOW WATER AT START OF YEAR	0.746	2706.260	2.82
SNOW WATER AT END OF YEAR	2.284	8290.994	8.65
ANNUAL WATER BUDGET BALANCE	0.0000	-0.052	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2016

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.89	2.05	4.18	1.99	3.57	0.61
	0.31	0.00	2.56	5.13	1.68	4.18
RUNOFF	0.411	4.150	0.381	0.000	0.000	0.000
	0.000	0.000	0.000	0.031	0.000	0.630
EVAPOTRANSPIRATION	0.261	0.279	1.175	2.804	3.302	0.962
	0.355	0.009	1.622	1.905	0.934	0.272

```
PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  4.9295  0.3675  0.0487  0.0462
  LAYER  1                       0.0000  0.0000  0.1616  2.5382  0.7769  0.1571

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                       ANNUAL TOTALS FOR YEAR 2016
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           29.15         105814.453    100.00

  RUNOFF                                   5.603         20338.338     19.22

  EVAPOTRANSPIRATION                      13.880         50385.199     47.62

  PERC./LEAKAGE THROUGH LAYER  1           9.025771      32763.549     30.96

  CHANGE IN WATER STORAGE                  0.641          2327.409      2.20

  SOIL WATER AT START OF YEAR              4.123         14966.931

  SOIL WATER AT END OF YEAR                4.304         15624.270

  SNOW WATER AT START OF YEAR              2.284          8290.994      7.84

  SNOW WATER AT END OF YEAR                2.744          9961.064      9.41

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.045      0.00

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               MONTHLY TOTALS (IN INCHES) FOR YEAR 2017
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                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------
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PRECIPITATION                    5.22    6.29    2.75    5.68    1.46    1.61
                                 0.39    0.47    2.29    0.39    4.26    2.45

RUNOFF                           1.213   8.906   2.333   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.006   0.144

EVAPOTRANSPIRATION               0.308   0.213   0.998   3.083   2.429   1.522
                                 0.546   0.482   1.639   0.876   0.618   0.364

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  3.9965  2.1811  0.1861  0.0308
  LAYER  1                       0.0056  0.0010  0.0070  0.0597  2.5544  0.3134

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                       ANNUAL TOTALS FOR YEAR 2017
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           33.26         120733.766    100.00

  RUNOFF                                  12.601         45742.758     37.89

  EVAPOTRANSPIRATION                      13.078         47471.891     39.32

  PERC./LEAKAGE THROUGH LAYER  1           9.335623      33888.312     28.07

  CHANGE IN WATER STORAGE                 -1.755         -6369.181     -5.28

  SOIL WATER AT START OF YEAR              4.304         15624.270

  SOIL WATER AT END OF YEAR                4.074         14790.104

  SNOW WATER AT START OF YEAR              2.744          9961.064      8.25

  SNOW WATER AT END OF YEAR                1.219          4426.048      3.67

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.014      0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2018

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.37	2.51	3.20	2.39	2.21	0.76
	0.08	0.76	0.00	1.46	2.44	2.01
RUNOFF	1.513	0.609	3.413	1.016	0.000	0.000
	0.000	0.000	0.000	0.000	0.039	0.018
EVAPOTRANSPIRATION	0.274	0.144	0.335	1.176	1.947	1.025
	0.081	0.731	0.027	1.376	0.622	0.349
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	4.8309	0.0001	0.0000
LAYER 1	0.0000	0.0000	0.0000	0.0027	0.0023	0.0000

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ANNUAL TOTALS FOR YEAR 2018

	INCHES	CU. FEET	PERCENT
PRECIPITATION	20.19	73289.656	100.00
RUNOFF	6.609	23992.000	32.74
EVAPOTRANSPIRATION	8.088	29357.637	40.06
PERC./LEAKAGE THROUGH LAYER 1	4.836035	17554.809	23.95
CHANGE IN WATER STORAGE	0.657	2385.243	3.25
SOIL WATER AT START OF YEAR	4.074	14790.104	
SOIL WATER AT END OF YEAR	3.909	14191.270	
SNOW WATER AT START OF YEAR	1.219	4426.048	6.04

SNOW WATER AT END OF YEAR	2.041	7410.127	10.11
ANNUAL WATER BUDGET BALANCE	0.0000	-0.036	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2015 THROUGH 2018

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.92	2.67	2.49	2.37	2.41	1.36
	0.71	0.96	1.30	1.75	2.64	2.88
STD. DEVIATIONS	1.25	1.63	1.00	1.10	1.20	1.18
	0.66	0.76	0.91	0.99	1.19	1.53
RUNOFF						
TOTALS	0.544	0.931	2.870	3.178	0.044	0.000
	0.000	0.000	0.000	0.001	0.010	0.276
STD. DEVIATIONS	0.730	1.755	1.574	3.357	0.130	0.000
	0.001	0.000	0.001	0.005	0.026	0.547
EVAPOTRANSPIRATION						
TOTALS	0.293	0.287	0.457	1.309	2.228	1.525
	0.734	0.888	1.125	1.016	0.631	0.321
STD. DEVIATIONS	0.060	0.077	0.304	0.749	0.873	1.059
	0.627	0.651	0.650	0.548	0.157	0.078
PERCOLATION/LEAKAGE THROUGH LAYER 1						
TOTALS	0.0000	0.0705	0.8770	2.3895	0.8964	0.0736
	0.0201	0.0140	0.0394	0.2523	0.9561	0.2487
STD. DEVIATIONS	0.0000	0.4170	1.6426	1.8576	1.4745	0.2300

0.0689 0.0724 0.1395 0.5419 0.8584 0.6621

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2015 THROUGH 2018

	INCHES		CU. FEET	PERCENT
PRECIPITATION	24.47	(4.786)	88822.9	100.00
RUNOFF	7.854	(3.5549)	28508.69	32.096
EVAPOTRANSPIRATION	10.813	(2.4035)	39251.52	44.191
PERCOLATION/LEAKAGE THROUGH LAYER 1	5.83758	(1.65221)	21190.424	23.85693
CHANGE IN WATER STORAGE	-0.035	(2.3173)	-127.65	-0.144

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PEAK DAILY VALUES FOR YEARS 2015 THROUGH 2018

	(INCHES)	(CU. FT.)
PRECIPITATION	1.66	6025.800
RUNOFF	1.880	6823.5229
PERCOLATION/LEAKAGE THROUGH LAYER 1	4.469978	16226.02150
SNOW WATER	16.52	59976.0469
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3204	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1020	

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FINAL WATER STORAGE AT END OF YEAR 2018

LAYER	(INCHES)	(VOL/VOL)
1	3.9094	0.1629
SNOW WATER	2.041	

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Pole Canyon ODA 2015 - 2018

Pole Canyon Cover

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**                                                                        **
**                                                                        **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                 **
**                    USAE WATERWAYS EXPERIMENT STATION                   **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                        **
**                                                                        **
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PRECIPITATION DATA FILE:    c:\PREC8418.D4
TEMPERATURE DATA FILE:      c:\TEMP8418.D7
SOLAR RADIATION DATA FILE:  c:\SOL8418.D13
EVAPOTRANSPIRATION DATA:    c:\PCCEVAPO.D11
SOIL AND DESIGN DATA FILE:  c:\PCCSOIL.D10
OUTPUT DATA FILE:           C:\PCCOUT18.OUT


TIME:  11:27     DATE:   4/25/2019


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     TITLE:  Pole Canyon Cover: Dinwoody 3ft, Chert 2ft

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
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```
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =     36.00   INCHES
          POROSITY                   =      0.4910 VOL/VOL
          FIELD CAPACITY             =      0.3000 VOL/VOL
          WILTING POINT              =      0.2000 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.3013 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.159999996000E-03 CM/SEC


                                  LAYER  2
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =     24.00   INCHES
          POROSITY                   =      0.2380 VOL/VOL
          FIELD CAPACITY             =      0.1300 VOL/VOL
          WILTING POINT              =      0.0700 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.1251 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-01 CM/SEC


                                  LAYER  3
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =     24.00   INCHES
          POROSITY                   =      0.3650 VOL/VOL
          FIELD CAPACITY             =      0.2390 VOL/VOL
          WILTING POINT              =      0.1020 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.2287 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.260000005000E-01 CM/SEC


                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
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        NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

       SCS RUNOFF CURVE NUMBER            =     86.00
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FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	36.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	10.845	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	17.676	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	7.200	INCHES
INITIAL SNOW WATER	=	3.699	INCHES
INITIAL WATER IN LAYER MATERIALS	=	19.335	INCHES
TOTAL INITIAL WATER	=	23.034	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
POCATELLO IDAHO

STATION LATITUDE	=	42.68 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.00
START OF GROWING SEASON (JULIAN DATE)	=	150
END OF GROWING SEASON (JULIAN DATE)	=	240
EVAPORATIVE ZONE DEPTH	=	36.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	3.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	69.70 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	54.70 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	45.10 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	67.70 %

NOTE: PRECIPITATION DATA FOR SMOKY CANYON MINE IDAHO

WAS ENTERED BY THE USER.

NOTE: TEMPERATURE DATA FOR SMOKY CANYON MINE IDAHO
WAS ENTERED BY THE USER.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO
AND STATION LATITUDE = 42.68 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2015

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.77	1.99	1.24	2.21	5.96	1.36
	1.39	1.37	1.90	1.07	2.88	3.28
RUNOFF	1.283	1.199	0.116	0.000	0.138	0.000
	0.000	0.000	0.000	0.000	0.021	0.403
EVAPOTRANSPIRATION	0.185	0.551	0.803	2.346	3.734	2.496
	5.165	1.306	1.247	1.017	0.509	0.345
PERCOLATION/LEAKAGE THROUGH	0.0000	2.1593	0.0000	0.5844	0.5797	1.2077
LAYER 3	0.5971	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 2015

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.42	95904.547	100.00
RUNOFF	3.161	11473.356	11.96
EVAPOTRANSPIRATION	19.704	71526.695	74.58
PERC./LEAKAGE THROUGH LAYER 3	5.128272	18615.625	19.41
CHANGE IN WATER STORAGE	-1.573	-5711.070	-5.95
SOIL WATER AT START OF YEAR	21.293	77293.195	
SOIL WATER AT END OF YEAR	18.181	65997.391	

SNOW WATER AT START OF YEAR	0.746	2706.260	2.82
SNOW WATER AT END OF YEAR	2.284	8290.994	8.65
ANNUAL WATER BUDGET BALANCE	0.0000	-0.059	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2016

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.89	2.05	4.18	1.99	3.57	0.61
	0.31	0.00	2.56	5.13	1.68	4.18
RUNOFF	0.521	4.348	0.403	0.008	0.014	0.000
	0.000	0.000	0.000	0.150	0.000	0.901
EVAPOTRANSPIRATION	0.261	0.279	1.121	2.346	3.072	1.593
	4.136	0.000	1.103	1.433	0.620	0.272
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.6268	1.8087	0.0000	0.0000
LAYER 3	0.5670	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 2016

	INCHES	CU. FEET	PERCENT
PRECIPITATION	29.15	105814.453	100.00
RUNOFF	6.346	23035.395	21.77

EVAPOTRANSPIRATION	16.235	58934.707	55.70
PERC./LEAKAGE THROUGH LAYER 3	3.002520	10899.147	10.30
CHANGE IN WATER STORAGE	3.566	12945.241	12.23
SOIL WATER AT START OF YEAR	18.181	65997.391	
SOIL WATER AT END OF YEAR	21.287	77272.562	
SNOW WATER AT START OF YEAR	2.284	8290.994	7.84
SNOW WATER AT END OF YEAR	2.744	9961.064	9.41
ANNUAL WATER BUDGET BALANCE	0.0000	-0.040	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2017

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.22	6.29	2.75	5.68	1.46	1.61
	0.39	0.47	2.29	0.39	4.26	2.45
RUNOFF	1.422	9.372	2.399	0.122	0.000	0.000
	0.000	0.000	0.000	0.000	0.042	0.264
EVAPOTRANSPIRATION	0.308	0.213	1.214	2.769	2.251	1.832
	4.496	0.364	1.115	0.977	0.545	0.364
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	2.6258	1.2990	1.3754	0.6518
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 2017

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.26	120733.766	100.00
RUNOFF	13.621	49443.785	40.95
EVAPOTRANSPIRATION	16.448	59704.750	49.45
PERC./LEAKAGE THROUGH LAYER 3	5.951979	21605.684	17.90
CHANGE IN WATER STORAGE	-2.760	-10020.409	-8.30
SOIL WATER AT START OF YEAR	21.287	77272.562	
SOIL WATER AT END OF YEAR	20.052	72787.164	
SNOW WATER AT START OF YEAR	2.744	9961.064	8.25
SNOW WATER AT END OF YEAR	1.219	4426.048	3.67
ANNUAL WATER BUDGET BALANCE	0.0000	-0.045	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2018

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.37	2.51	3.20	2.39	2.21	0.76
	0.08	0.76	0.00	1.46	2.44	2.01
RUNOFF	1.990	0.682	3.491	0.992	0.000	0.000
	0.000	0.000	0.000	0.000	0.070	0.032
EVAPOTRANSPIRATION	0.274	0.200	0.410	1.919	1.928	1.712
	3.613	0.320	0.164	0.980	0.513	0.349
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.0000	0.0000	0.0000	1.8610	0.6539	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 2018

	INCHES	CU. FEET	PERCENT
PRECIPITATION	20.19	73289.656	100.00
RUNOFF	7.258	26345.061	35.95
EVAPOTRANSPIRATION	12.383	44949.582	61.33
PERC./LEAKAGE THROUGH LAYER 3	2.514938	9129.227	12.46
CHANGE IN WATER STORAGE	-1.965	-7134.194	-9.73
SOIL WATER AT START OF YEAR	20.052	72787.164	
SOIL WATER AT END OF YEAR	17.264	62668.895	
SNOW WATER AT START OF YEAR	1.219	4426.048	6.04
SNOW WATER AT END OF YEAR	2.041	7410.127	10.11
ANNUAL WATER BUDGET BALANCE	0.0000	-0.022	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2015 THROUGH 2018

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION						
TOTALS	2.92	2.67	2.49	2.37	2.41	1.36
	0.71	0.96	1.30	1.75	2.64	2.88
STD. DEVIATIONS	1.25	1.63	1.00	1.10	1.20	1.18
	0.66	0.76	0.91	0.99	1.19	1.53
RUNOFF						
TOTALS	0.644	1.012	2.974	3.090	0.066	0.007
	0.000	0.000	0.001	0.005	0.029	0.374
STD. DEVIATIONS	0.820	1.854	1.550	3.322	0.133	0.029
	0.003	0.001	0.004	0.025	0.063	0.670
EVAPOTRANSPIRATION						
TOTALS	0.295	0.293	0.449	1.390	2.204	1.908
	4.348	0.897	0.949	0.787	0.463	0.308
STD. DEVIATIONS	0.058	0.076	0.277	0.615	0.745	0.854
	0.494	0.722	0.530	0.321	0.103	0.063
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0013	0.0627	0.1598	0.4068	0.6075	0.3556
	0.3984	0.0217	0.0077	0.0035	0.0024	0.0553
STD. DEVIATIONS	0.0056	0.3648	0.5182	0.6860	0.8102	0.5022
	0.4973	0.0744	0.0399	0.0162	0.0110	0.3167

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2015 THROUGH 2018

	INCHES	CU. FEET	PERCENT
PRECIPITATION	24.47 (4.786)	88822.9	100.00
RUNOFF	8.203 (3.6057)	29775.57	33.522
EVAPOTRANSPIRATION	14.290 (2.1718)	51873.84	58.401

PERCOLATION/LEAKAGE THROUGH LAYER 3	2.08271 (1.45283)	7560.231	8.51158
CHANGE IN WATER STORAGE	-0.107 (2.7656)	-386.68	-0.435

****

****

PEAK DAILY VALUES FOR YEARS 2015 THROUGH 2018

	(INCHES)	(CU. FT.)
PRECIPITATION	1.66	6025.800
RUNOFF	1.921	6971.5625
PERCOLATION/LEAKAGE THROUGH LAYER 3	1.562221	5670.86279
SNOW WATER	16.52	59976.0469
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4408	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2000	

****

****

FINAL WATER STORAGE AT END OF YEAR 2018

LAYER	(INCHES)	(VOL/VOL)
1	9.3997	0.2611
2	2.7935	0.1164
3	5.0710	0.2113
SNOW WATER	2.041	

```
********************************************************************************
********************************************************************************
```

Pole Canyon ODA 2015 - 2018

Panel A Thin Topsoil Cover

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************
```

```
PRECIPITATION DATA FILE:    c:\PREC8418.D4
TEMPERATURE DATA FILE:      c:\TEMP8418.D7
SOLAR RADIATION DATA FILE:  c:\SOL8418.D13
EVAPOTRANSPIRATION DATA:    c:\TTCEVAPO.D11
SOIL AND DESIGN DATA FILE:  c:\TTCSOIL.D10
OUTPUT DATA FILE:           C:\TTCOUT18.OUT
```

TIME: 11:52   DATE: 4/25/2019

****

TITLE: Thin Topsoil Cover: Topsoil 0.5 ft

****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER


```
                  MATERIAL TEXTURE NUMBER   0
THICKNESS                  =      6.00   INCHES
POROSITY                   =      0.4910 VOL/VOL
FIELD CAPACITY             =      0.2000 VOL/VOL
WILTING POINT              =      0.1100 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.2874 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.890000010000E-04 CM/SEC
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER

```
                  MATERIAL TEXTURE NUMBER   0
THICKNESS                  =     24.00   INCHES
POROSITY                   =      0.3650 VOL/VOL
FIELD CAPACITY             =      0.2390 VOL/VOL
WILTING POINT              =      0.1020 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.1466 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.260000005000E-01 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

```
SCS RUNOFF CURVE NUMBER             =     86.00
FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     24.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      4.364  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      9.516  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.496  INCHES
INITIAL SNOW WATER                  =      3.699  INCHES
INITIAL WATER IN LAYER MATERIALS    =      5.243  INCHES
TOTAL INITIAL WATER                 =      8.942  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
POCATELLO IDAHO

STATION LATITUDE	=	42.68 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	150
END OF GROWING SEASON (JULIAN DATE)	=	240
EVAPORATIVE ZONE DEPTH	=	24.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	3.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	69.70 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	54.70 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	45.10 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	67.70 %

NOTE: PRECIPITATION DATA FOR SMOKY CANYON MINE IDAHO

WAS ENTERED BY THE USER.

NOTE: TEMPERATURE DATA FOR SMOKY CANYON MINE IDAHO
WAS ENTERED BY THE USER.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO
AND STATION LATITUDE = 42.68 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2015

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.77	1.99	1.24	2.21	5.96	1.36
	1.39	1.37	1.90	1.07	2.88	3.28

RUNOFF	0.920	0.965	0.084	0.000	0.022	0.000
	0.000	0.000	0.000	0.000	0.011	0.347
EVAPOTRANSPIRATION	0.148	0.529	0.904	2.833	3.855	2.627
	1.662	1.427	1.622	1.019	0.512	0.327
PERCOLATION/LEAKAGE THROUGH	0.0000	2.5360	0.1546	0.2352	0.9669	0.3399
LAYER 2	0.0569	0.0510	0.0012	0.0012	0.4172	0.0000

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ANNUAL TOTALS FOR YEAR 2015

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.42	95904.547	100.00
RUNOFF	2.351	8534.600	8.90
EVAPOTRANSPIRATION	17.466	63401.828	66.11
PERC./LEAKAGE THROUGH LAYER 2	4.760042	17278.953	18.02
CHANGE IN WATER STORAGE	1.843	6689.229	6.97
SOIL WATER AT START OF YEAR	5.549	20143.348	
SOIL WATER AT END OF YEAR	5.853	21247.844	
SNOW WATER AT START OF YEAR	0.746	2706.260	2.82
SNOW WATER AT END OF YEAR	2.284	8290.994	8.65
ANNUAL WATER BUDGET BALANCE	0.0000	-0.066	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2016

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.89	2.05	4.18	1.99	3.57	0.61
	0.31	0.00	2.56	5.13	1.68	4.18
RUNOFF	0.459	4.194	0.378	0.000	0.000	0.000
	0.000	0.000	0.000	0.121	0.000	0.743
EVAPOTRANSPIRATION	0.261	0.279	1.168	2.984	3.298	1.443
	0.591	0.000	1.396	1.809	0.867	0.272
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	4.3069	0.9260	0.0723	0.0233
LAYER 2	0.0698	0.0000	0.0070	1.5934	1.3105	0.0778

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ANNUAL TOTALS FOR YEAR 2016

	INCHES	CU. FEET	PERCENT
PRECIPITATION	29.15	105814.453	100.00
RUNOFF	5.895	21398.842	20.22
EVAPOTRANSPIRATION	14.368	52157.488	49.29
PERC./LEAKAGE THROUGH LAYER 2	8.386972	30444.709	28.77
CHANGE IN WATER STORAGE	0.500	1813.499	1.71
SOIL WATER AT START OF YEAR	5.853	21247.844	
SOIL WATER AT END OF YEAR	5.893	21391.271	
SNOW WATER AT START OF YEAR	2.284	8290.994	7.84
SNOW WATER AT END OF YEAR	2.744	9961.064	9.41
ANNUAL WATER BUDGET BALANCE	0.0000	-0.090	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2017

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.22	6.29	2.75	5.68	1.46	1.61
	0.39	0.47	2.29	0.39	4.26	2.45
RUNOFF	1.271	8.925	2.334	0.006	0.000	0.000
	0.000	0.000	0.001	0.000	0.027	0.195
EVAPOTRANSPIRATION	0.308	0.213	1.295	3.048	2.743	1.549
	1.001	0.283	1.407	1.428	0.599	0.364
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	3.4365	1.7842	0.5827	0.0625
LAYER 2	0.0876	0.0333	0.0035	0.0033	1.5423	0.2750

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ANNUAL TOTALS FOR YEAR 2017

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.26	120733.766	100.00
RUNOFF	12.758	46309.809	38.36
EVAPOTRANSPIRATION	14.237	51681.113	42.81
PERC./LEAKAGE THROUGH LAYER 2	7.810879	28353.492	23.48
CHANGE IN WATER STORAGE	-1.546	-5610.621	-4.65

SOIL WATER AT START OF YEAR	5.893	21391.271	
SOIL WATER AT END OF YEAR	5.872	21315.668	
SNOW WATER AT START OF YEAR	2.744	9961.064	8.25
SNOW WATER AT END OF YEAR	1.219	4426.048	3.67
ANNUAL WATER BUDGET BALANCE	0.0000	-0.023	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2018

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.37	2.51	3.20	2.39	2.21	0.76
	0.08	0.76	0.00	1.46	2.44	2.01
RUNOFF	1.617	0.616	3.424	1.016	0.002	0.000
	0.000	0.000	0.000	0.000	0.066	0.030
EVAPOTRANSPIRATION	0.274	0.151	0.343	2.222	1.788	1.221
	0.125	0.594	0.204	1.155	0.575	0.349
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	4.3269	0.0558	0.0238
LAYER 2	0.0775	0.0553	0.0000	0.0009	0.0133	0.0000

****

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ANNUAL TOTALS FOR YEAR 2018

	INCHES	CU. FEET	PERCENT
PRECIPITATION	20.19	73289.656	100.00

RUNOFF	6.772	24581.268	33.54
EVAPOTRANSPIRATION	9.001	32672.697	44.58
PERC./LEAKAGE THROUGH LAYER 2	4.553635	16529.693	22.55
CHANGE IN WATER STORAGE	-0.136	-493.979	-0.67
SOIL WATER AT START OF YEAR	5.872	21315.668	
SOIL WATER AT END OF YEAR	4.914	17837.609	
SNOW WATER AT START OF YEAR	1.219	4426.048	6.04
SNOW WATER AT END OF YEAR	2.041	7410.127	10.11
ANNUAL WATER BUDGET BALANCE	0.0000	-0.024	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2015 THROUGH 2018

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.92	2.67	2.49	2.37	2.41	1.36
	0.71	0.96	1.30	1.75	2.64	2.88
STD. DEVIATIONS	1.25	1.63	1.00	1.10	1.20	1.18
	0.66	0.76	0.91	0.99	1.19	1.53
RUNOFF						
TOTALS	0.578	0.948	2.918	3.169	0.053	0.001
	0.001	0.001	0.001	0.004	0.020	0.319
STD. DEVIATIONS	0.752	1.761	1.570	3.348	0.132	0.003
	0.003	0.002	0.004	0.020	0.042	0.594

```
 EVAPOTRANSPIRATION
 ------------------
   TOTALS              0.293    0.288    0.467    1.608    2.445    1.788
                       0.920    0.805    1.091    1.002    0.588    0.319

   STD. DEVIATIONS     0.060    0.076    0.322    0.825    0.934    1.146
                       0.667    0.634    0.624    0.516    0.148    0.075

 PERCOLATION/LEAKAGE THROUGH LAYER  2
 ------------------------------------
   TOTALS              0.0000   0.0725   0.7889   2.2009   0.7718   0.1139
                       0.0608   0.0296   0.0160   0.1150   0.5249   0.2065

   STD. DEVIATIONS     0.0000   0.4287   1.4740   1.6664   1.3075   0.1684
                       0.0362   0.0219   0.0178   0.3041   0.6555   0.5720

*******************************************************************************


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    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2015 THROUGH 2018
-------------------------------------------------------------------------------
                                    INCHES            CU. FEET      PERCENT
                               -------------------  -------------  ---------
 PRECIPITATION                 24.47    (   4.786)     88822.9      100.00

 RUNOFF                         8.012   (  3.5571)     29082.68      32.742

 EVAPOTRANSPIRATION            11.613   (  2.4621)     42156.74      47.462

 PERCOLATION/LEAKAGE THROUGH    4.90071 (  1.42161)    17789.586     20.02814
   LAYER  2

 CHANGE IN WATER STORAGE       -0.057   (  2.4589)      -206.03      -0.232

*******************************************************************************


******************************************************************************

            PEAK DAILY VALUES FOR YEARS 2015 THROUGH 2018
   ------------------------------------------------------------------------
                                                   (INCHES)      (CU. FT.)
```



```
                                                ----------    -------------
      PRECIPITATION                               1.66           6025.800

      RUNOFF                                      1.881          6826.3159

      PERCOLATION/LEAKAGE THROUGH LAYER  2        4.597135      16687.59960

      SNOW WATER                                 16.52          59976.0469


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                 0.3537

      MINIMUM VEG. SOIL WATER (VOL/VOL)                 0.1040

*******************************************************************************


*******************************************************************************

                   FINAL WATER STORAGE AT END OF YEAR 2018
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1           2.2541         0.3757

                      2           2.6598         0.1108

                   SNOW WATER     2.041

*******************************************************************************
*******************************************************************************
```

Pole Canyon ODA 2015 - 2018

Undisturbed Natural Ground

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    c:\PREC8418.D4
TEMPERATURE DATA FILE:      c:\TEMP8418.D7
SOLAR RADIATION DATA FILE:  c:\SOL8418.D13
EVAPOTRANSPIRATION DATA:    c:\UNGEVAPO.D11
SOIL AND DESIGN DATA FILE:  c:\UNGSOIL.D10
OUTPUT DATA FILE:           C:\UNGOUT18.OUT


TIME:  11:59     DATE:   4/25/2019


******************************************************************************

     TITLE:  Undisturbed Natural Ground

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
```



```
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =    36.00   INCHES
          POROSITY                   =     0.4910 VOL/VOL
          FIELD CAPACITY             =     0.2000 VOL/VOL
          WILTING POINT              =     0.1100 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1857 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.890000010000E-04 CM/SEC


                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ----------------------------------------

        NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

       SCS RUNOFF CURVE NUMBER             =    86.00
       FRACTION OF AREA ALLOWING RUNOFF    =   100.0    PERCENT
       AREA PROJECTED ON HORIZONTAL PLANE  =     1.000  ACRES
       EVAPORATIVE ZONE DEPTH              =    36.0    INCHES
       INITIAL WATER IN EVAPORATIVE ZONE   =     6.684  INCHES
       UPPER LIMIT OF EVAPORATIVE STORAGE  =    17.676  INCHES
       LOWER LIMIT OF EVAPORATIVE STORAGE  =     3.960  INCHES
       INITIAL SNOW WATER                  =     3.699  INCHES
       INITIAL WATER IN LAYER MATERIALS    =     6.684  INCHES
       TOTAL INITIAL WATER                 =    10.383  INCHES
       TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR


                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

        NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                 POCATELLO            IDAHO

            STATION LATITUDE                    =  42.68 DEGREES
            MAXIMUM LEAF AREA INDEX             =   3.50
            START OF GROWING SEASON (JULIAN DATE) =    150
            END OF GROWING SEASON (JULIAN DATE)   =    240
            EVAPORATIVE ZONE DEPTH              =  36.0  INCHES
            AVERAGE ANNUAL WIND SPEED           =   3.60 MPH
            AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  69.70 %
            AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  54.70 %
            AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  45.10 %
            AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  67.70 %
```

NOTE: PRECIPITATION DATA FOR SMOKY CANYON MINE IDAHO
WAS ENTERED BY THE USER.

NOTE: TEMPERATURE DATA FOR SMOKY CANYON MINE IDAHO
WAS ENTERED BY THE USER.

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO
AND STATION LATITUDE = 42.68 DEGREES

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 2015

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.77	1.99	1.24	2.21	5.96	1.36
	1.39	1.37	1.90	1.07	2.88	3.28
RUNOFF	1.196	1.069	0.137	0.000	0.298	0.000
	0.000	0.000	0.000	0.000	0.024	0.390
EVAPOTRANSPIRATION	0.206	0.516	0.555	1.669	2.771	2.927
	5.157	0.810	0.680	0.617	0.459	0.346
PERCOLATION/LEAKAGE THROUGH	0.0000	0.1823	0.5123	0.6710	1.9548	1.2287
LAYER 1	1.1129	0.4447	0.3271	0.3006	0.6044	0.0000

****

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ANNUAL TOTALS FOR YEAR 2015

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.42	95904.547	100.00
RUNOFF	3.115	11305.643	11.79
EVAPOTRANSPIRATION	16.714	60670.437	63.26
PERC./LEAKAGE THROUGH LAYER 1	7.338775	26639.752	27.78
CHANGE IN WATER STORAGE	-0.747	-2711.237	-2.83
SOIL WATER AT START OF YEAR	9.459	34336.566	
SOIL WATER AT END OF YEAR	7.174	26040.596	
SNOW WATER AT START OF YEAR	0.746	2706.260	2.82
SNOW WATER AT END OF YEAR	2.284	8290.994	8.65
ANNUAL WATER BUDGET BALANCE	0.0000	-0.052	0.00

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 2016

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.89	2.05	4.18	1.99	3.57	0.61
	0.31	0.00	2.56	5.13	1.68	4.18
RUNOFF	0.483	4.010	0.333	0.022	0.033	0.000
	0.000	0.000	0.000	0.104	0.000	0.859
EVAPOTRANSPIRATION	0.261	0.279	1.013	1.651	2.476	1.957
	3.067	0.000	0.641	0.968	0.384	0.272

PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	1.5731	1.7646	0.5496	0.8291
LAYER 1	0.7976	0.0000	0.6005	1.9049	0.1314	0.2016

****

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ANNUAL TOTALS FOR YEAR 2016

	INCHES	CU. FEET	PERCENT
PRECIPITATION	29.15	105814.453	100.00
RUNOFF	5.844	21214.781	20.05
EVAPOTRANSPIRATION	12.968	47073.078	44.49
PERC./LEAKAGE THROUGH LAYER 1	8.352354	30319.045	28.65
CHANGE IN WATER STORAGE	1.986	7207.617	6.81
SOIL WATER AT START OF YEAR	7.174	26040.596	
SOIL WATER AT END OF YEAR	8.699	31578.143	
SNOW WATER AT START OF YEAR	2.284	8290.994	7.84
SNOW WATER AT END OF YEAR	2.744	9961.064	9.41
ANNUAL WATER BUDGET BALANCE	0.0000	-0.069	0.00

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 2017

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION	5.22	6.29	2.75	5.68	1.46	1.61
	0.39	0.47	2.29	0.39	4.26	2.45
RUNOFF	1.354	8.901	2.220	0.261	0.000	0.000
	0.000	0.000	0.000	0.000	0.065	0.258
EVAPOTRANSPIRATION	0.308	0.213	0.876	1.937	2.134	2.092
	5.880	0.313	0.765	0.403	0.399	0.359
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.4175	0.9785	2.0980	0.4560
LAYER 1	0.7570	0.1028	0.3566	0.2002	0.4052	0.3455

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ANNUAL TOTALS FOR YEAR 2017

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.26	120733.766	100.00
RUNOFF	13.058	47401.367	39.26
EVAPOTRANSPIRATION	15.680	56918.223	47.14
PERC./LEAKAGE THROUGH LAYER 1	6.117305	22205.816	18.39
CHANGE IN WATER STORAGE	-1.595	-5791.636	-4.80
SOIL WATER AT START OF YEAR	8.699	31578.143	
SOIL WATER AT END OF YEAR	8.629	31321.523	
SNOW WATER AT START OF YEAR	2.744	9961.064	8.25
SNOW WATER AT END OF YEAR	1.219	4426.048	3.67
ANNUAL WATER BUDGET BALANCE	0.0000	-0.002	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2018

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.37	2.51	3.20	2.39	2.21	0.76
	0.08	0.76	0.00	1.46	2.44	2.01
RUNOFF	1.802	0.589	3.153	0.821	0.000	0.000
	0.000	0.000	0.000	0.000	0.066	0.028
EVAPOTRANSPIRATION	0.274	0.245	0.520	1.706	2.037	1.896
	4.258	0.240	0.101	0.618	0.418	0.349
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	1.0554	0.5373	0.2020
LAYER 1	0.3125	0.0717	0.0332	0.0921	0.5860	0.0000

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ANNUAL TOTALS FOR YEAR 2018

	INCHES	CU. FEET	PERCENT
PRECIPITATION	20.19	73289.656	100.00
RUNOFF	6.459	23445.348	31.99
EVAPOTRANSPIRATION	12.662	45963.004	62.71
PERC./LEAKAGE THROUGH LAYER 1	2.890269	10491.675	14.32
CHANGE IN WATER STORAGE	-1.821	-6610.328	-9.02
SOIL WATER AT START OF YEAR	8.629	31321.523	
SOIL WATER AT END OF YEAR	5.985	21727.117	
SNOW WATER AT START OF YEAR	1.219	4426.048	6.04
SNOW WATER AT END OF YEAR	2.041	7410.127	10.11
ANNUAL WATER BUDGET BALANCE	0.0000	-0.045	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2015 THROUGH 2018

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.92	2.67	2.49	2.37	2.41	1.36
	0.71	0.96	1.30	1.75	2.64	2.88
STD. DEVIATIONS	1.25	1.63	1.00	1.10	1.20	1.18
	0.66	0.76	0.91	0.99	1.19	1.53
RUNOFF						
TOTALS	0.590	0.919	2.665	2.849	0.076	0.012
	0.001	0.001	0.002	0.004	0.027	0.351
STD. DEVIATIONS	0.752	1.735	1.418	3.121	0.151	0.041
	0.005	0.002	0.006	0.018	0.055	0.638
EVAPOTRANSPIRATION						
TOTALS	0.296	0.295	0.416	1.174	2.045	1.917
	3.958	0.634	0.575	0.534	0.389	0.302
STD. DEVIATIONS	0.057	0.072	0.212	0.443	0.436	0.678
	1.007	0.600	0.300	0.212	0.108	0.063
PERCOLATION/LEAKAGE THROUGH LAYER 1						
TOTALS	0.0000	0.0052	0.1742	0.6518	0.8534	0.4958
	0.7587	0.2905	0.2857	0.3691	0.5368	0.0852
STD. DEVIATIONS	0.0000	0.0308	0.4024	0.5577	0.6060	0.4213

0.2799 0.2890 0.1904 0.3927 0.3684 0.2173

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2015 THROUGH 2018

	INCHES		CU. FEET	PERCENT
PRECIPITATION	24.47	(4.786)	88822.9	100.00
RUNOFF	7.495	(3.4281)	27207.97	30.632
EVAPOTRANSPIRATION	12.535	(2.0486)	45501.39	51.227
PERCOLATION/LEAKAGE THROUGH LAYER 1	4.50633	(1.43944)	16357.986	18.41640
CHANGE IN WATER STORAGE	-0.067	(2.4858)	-244.36	-0.275

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PEAK DAILY VALUES FOR YEARS 2015 THROUGH 2018

	(INCHES)	(CU. FT.)
PRECIPITATION	1.66	6025.800
RUNOFF	1.876	6810.3433
PERCOLATION/LEAKAGE THROUGH LAYER 1	0.295096	1071.19995
SNOW WATER	16.52	59976.0469
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.3867
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1100

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FINAL WATER STORAGE AT END OF YEAR 2018

LAYER	(INCHES)	(VOL/VOL)
1	5.9854	0.1663
SNOW WATER	2.041	

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APPENDIX F

Evaluation of Vegetation Monitoring Data

APPENDIX F

EVALUATION OF VEGETATION MONITORING DATA

Vegetation community monitoring and tissue sample collection was conducted on July 17, 2018 to assess vegetation cover conditions and determine selenium concentrations in vegetation growing on the Pole Canyon Overburden Disposal Area (ODA) 2013 Non-Time-Critical Removal Action (NTCRA) Dinwoody/Chert cover system. Construction of the cover system was completed in 2015, with minor follow-up construction completed in 2016. Monitoring was conducted approximately 3 years after the cover was seeded, to allow time for the vegetation to become established. The vegetation monitoring was performed in accordance with methods and standard operating procedures (SOPs) outlined in the Final Pole Canyon Overburden Disposal Area Non-Time-Critical Removal Actions Effectiveness Monitoring Plan (EMP), Revision No. 5 (Formation 2018).

The Pole Canyon ODA was divided into six vegetation monitoring zones as shown on Figure F-1. General forage vegetation samples were collected as a composite sample in each zone (for a total of six samples) and submitted for selenium analysis. Vegetation monitoring methods are described in Section F.1. Vegetation tissue sampling results are presented in Section F.2. Quantitative vegetation community monitoring was performed along two transects in each zone (for a total of 12 transects), and general conditions were noted, and photo documentation was collected within each zone. Vegetation community results are presented in Section F.3. References cited are provided in Section F.4.

F.1 Vegetation Monitoring Methods

Vegetation monitoring zones at the Pole Canyon ODA are based on the slope and aspect of the cover system (Figure F-1). The six zones are as follows:

- Zone 1 East side east-facing slope at top of Pole Canyon NTCRA
- Zone 2 East side flat area at top of Pole Canyon NTCRA
- Zone 3 East-facing slope above east sedimentation basin
- Zone 4 East side south-facing slope above south-central sedimentation basin
- Zone 5 West side slope above west-side south sedimentation basin
- Zone 6 West side slope above west infiltration basin

Within each zone, a 50-meter x 50-meter (165-foot x 165-foot) plot was established for plant tissue sample collection.[1] One composite vegetation sample was collected within the sampling plot, consisting of five sub-samples collected from five randomly identified locations within each plot. Each vegetation sub-sample consisted of vegetative material that was collected by cutting the material with clean scissors from a 30-centimeter x 30-centimeter (12-inch x 12-inch) quadrat. The vegetation increments were combined as they were collected into a single labeled re-sealable bag to create the composite sample for each plot/zone. All vegetation types (forbs and grasses) were included in the composite sample. A field sampling form was completed for each sample detailing the contents of the sample including the approximate percentages of the dominant species. All vegetation samples were submitted to the laboratory as unwashed samples, but the samples were washed of adhering particles by the laboratory prior to drying, homogenization, and preparation for analysis. Vegetation samples were analyzed for selenium using EPA Method 7742. One equipment rinsate sample was also submitted for selenium analysis.

Quantitative vegetation community and cover monitoring using the Point-Intercept Method was performed along two 50-meter (165-foot) transects laid out within each zone to assess representative cover conditions. Transect locations within each zone are shown on Figure F-1. The Point-Intercept Method involves making observations at regular increments along the transect using a pin to record “hits” of plants, bare ground, or other ground cover (e.g., rocks, wood, etc.). Observations were made every foot, for a total of 165 observation points per transect; if multiple plant species were encountered at a point, then the total number of hits was greater than 165. Species that were observed on the Dinwoody/Chert cover system, but not encountered at the observation points, were also recorded. The data were used to calculate estimates of ground cover, cover by individual species, and species diversity. Photos were collected from the center of each sampling area (looking north, south, west, east) and from the ends of the monitoring transects. General conditions regarding overall vegetation density and robustness, signs of vegetation distress or discolorations, or patches of known selenium-accumulators (e.g., alfalfa, yellow sweet clover, aster, etc.) or noxious weeds were also noted.

F.2 Vegetation Tissue Sampling Results

Selenium concentrations in the six composite vegetation samples (containing a mixture of forbs and grasses) ranged from non-detect to 0.246 milligrams per kilogram (mg/kg), with an average of 0.085 mg/kg. Vegetation tissue sampling results are presented on Table F-1. The vegetation sample from Zone 2 had the highest selenium concentration (0.246 mg/kg) and this was the only sample containing material from a selenium-accumulating species (yellow sweet clover [*Melilotus officinalis*])[2].

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[1] Zone 2 was augmented in April 2018 with topsoil and seed to improve the vegetation cover. Because the newer vegetation growth was sparser than in other zones, the forage composite sample in Zone 2 was collected from 8 sub-samples from throughout the entire zone, rather than from within the 50-meter x 50-meter sampling plot.

[2] Yellow sweet clover was present in other zones but not within the tissue sampling areas (see Section F.3).

Implementation of the 2013 NTCRA was expected to result in reductions in selenium concentrations in vegetation growing on the Dinwoody/Chert cover system, relative to pre-NTCRA conditions. Selenium concentrations in pre-NTCRA forage vegetation growing on the cover system ranged from 1.1 to 145 mg/kg, with an average of 18 mg/kg (based on 47 samples from 17 vegetation locations: PT-7 through PT-13 and PCO-5 through PCO-14). The null and alternate hypotheses developed for decision-making regarding the effectiveness of the Pole Canyon ODA Dinwoody/Chert Cover NTCRA were outlined in the EMP (Formation 2018).

These 2018 vegetation monitoring data confirm that average selenium concentrations in post-NTCRA vegetation (0.085 mg/kg) have decreased relative to the pre-NTCRA average concentration (18 mg/kg) (Table F-1, Figure F-2). In addition to the boxplot comparison, a non-parametric test[3] was used to determine that post-NTCRA results are statistically lower than pre-NTCRA conditions. The null hypothesis was rejected, and the alternate hypothesis that the Dinwoody/Chert Cover NTCRA is effective in reducing or eliminating potential risks from ingestion of vegetation growing on the Pole Canyon ODA is accepted. Further, the decision rule for evaluating the effectiveness of the Pole Canyon 2013 Dinwoody/Chert Cover NTCRA has been met and no cover modifications or additional vegetation monitoring are needed.

F.3 Vegetation Community Monitoring Results

Overall, the Pole Canyon ODA vegetation cover is representative of a mixed-grassland in an early-successional status. Representative photos of the vegetation conditions in each zone in July 2018 are presented in Figures F-3 to F-8. Vegetation cover estimates are provided in Table F-2. As indicated above, Zone 2 was augmented in April 2018 with topsoil and seed and so the monitoring results in that zone (17 percent [%] vegetation cover and no litter cover) reflect just three months of new growth. Vegetation coverage in the other zones ranged from 23 to 51%, litter was 5 to 16% of the ground cover, and bare ground was 6 to 30% of the ground cover. In all zones, the vegetation growth ranged from areas with sparse vegetation and bare ground patches to more dense areas with robust, tall grass growth and litter accumulation. The vegetation cover in Zone 6 (23% vegetation cover and 66% rock cover) reflects the drier, rockier substrate on that slope than was observed on the transects of other zones.

[3] U.S. Environmental Protection Agency (USEPA) ProUCL Software (version 5.1; USEPA 2016) was used to first determine the data distribution of the pre- and post-NTCRA datasets. Because one of the datasets was not distributed normally, the non-parametric Wilcoxon-Mann-Whitney Two-Sample Test was used to compare the medians of the two datasets at the 90 percent confidence level.

The reclamation areas had a variable suite of seeded and non-seeded grasses and forbs. The seed mix included ten grass and seven forb species:

Grasses

- Mountain brome (*Bromus marginatus*)
- Orchardgrass (*Dactylis glomerata*)
- Blue wildrye (*Elymus glaucus*)
- Thickspike wheatgrass (*Elymus lanceolatus*)
- Slender wheatgrass (*Elymus trachycaulus*)
- Rocky Mountain fescue (*Festuca saximontana*)
- Great Basin wildrye (*Leymus cinereus*)
- Western wheatgrass (*Pascopyrum smithii*)
- Big bluegrass (*Poa secunda*)
- Sterile wheat (*Triticum aestivum* x *Secale cereal*)

Forbs

- Common yarrow (*Achillea millefolium*)
- Arrowleaf balsamroot (*Balsamorhiza sagittata*)
- Showy goldeneye (*Heliomeris multiflora*)
- Lewis flax (*Linum lewisii*)
- Rocky Mountain penstemon (*Penstemon strictus*)
- Small burnet (*Sanguisorba minor*)
- White clover (*Trifolium repens*)

Tables F-3 and F-4 present the presence and abundance of seeded and non-seeded species, respectively. Seeded grasses and forbs made up 83 to 100% of the vegetation along transects in all of the zones, except Zone 2 (51%). Of the seeded species, grasses were the dominant vegetation (82 to 94%) (Table F-3). Orchardgrass, wheatgrasses, Rocky Mountain fescue, and Mountain brome were the most common seeded grasses and Small burnet and yarrow were the most common seeded forbs. Species diversity (number of species) ranged from 10 to 13 seeded species and 4 to 14 non-seeded species in each zone. Zones 1 and 2 had the highest diversity of non-seeded species (Table F-4). The most commonly encountered non-seeded species were ruderal/weedy species such as knotweeds (*Polygonum* spp.), tall annual willowherb (*Epilobium brachycarpum*), prickly lettuce (*Lactuca serriola*), and salsify (*Tragopogon dubius*). A few alfalfa plants (*Medicago sativa*, selenium-accumulating species) were recorded in Zones 4, 5, and 6. Yellow sweet clover, also a selenium-accumulating species, was observed in all zones (Table F-4), with larger patches noted in Zones 1 and 6. A few plants of two noxious weed species were seen; musk thistle (*Carduus nutans*) was noted in three of the zones and Canada thistle (*Cirsium arvense*) was noted in one zone (Table F-4).

As noted in Section 2 of the 2018 PEMR, the cover is inspected semiannually to assess the general condition, erosion, vegetative growth, wattle conditions, and presence of undesirable species, and maintenance is performed as needed. Noxious weed control was performed and targeted species including musk thistle, Canada thistle, and houndstongue. Milestone® at 15 gallons per acre and was applied with backpack sprayers and/or a truck-hose/handgun. These inspection activities will continue as per the Post-Removal Site Control (PRSC) Plan (Formation 2016) and the EMP (Formation 2018).

F.4 References

Formation Environmental, LLC (Formation). 2016. Pole Canyon Overburden Disposal Area 2013 Non-Time-Critical Removal Action Post-Removal Site Control Plan. Prepared for J.R. Simplot Company, September.

Formation Environmental, LLC (Formation). 2018. Final Pole Canyon Overburden Disposal Area Non-Time-Critical Removal Actions Effectiveness Monitoring Plan, Revision No. 5. Prepared for the J.R. Simplot Company Smoky Canyon Mine. March.

U.S. Environmental Protection Agency (USEPA). 2016. ProUCL software, version 5.1.002 Available at https://www.epa.gov/land-research/proucl-software (last updated June 20, 2016).

Table F-1
Selenium Concentrations in Forage Vegetation

Zone (Sample ID)	Location Description	Selenium (mg/kg)	Forage Sample Species (% Composition)
Zone 1 (PCO-15)	East side west-facing slope at top of Pole Canyon ODA	0.037 J	ELYLAN (45.6), EPIBRA (25.8), LAPOCC (10), BROMAR (6.8), DACGLO (6.6), CAPBUR (3), LACSER (2), ACHMIL (0.2)
Zone 2 (PCO-16)	East side flat area at top of Pole Canyon ODA	0.246	MELOFF (16), TRIAESxSECCER (10), RUMSPP (10), ACHMIL (10), EPIBRA (8), DACGLO (8), BROMAR (8), POLAVI (8), LACSER (8), ANTCOT (8), LAPOCC (6)
Zone 3 (PCO-17)	East-facing slope above east sedimentation basin	0.057	DACGLO (54.46), SANMIN (27), FESSAX (11.86), ACHMIL (6.66)
Zone 4 (PCO-18)	East side south-facing slope above south-central sedimentation basin	0.034 J	ELYTRA (44.8), EPIBRA (21), DACGLO (14), POASEC (10), FESSAX (9.8), LACSER (0.4)
Zone 5 (PCO-19)	West side slope above south sedimentation basin	0.02 U	ACHMIL (28), ELYLAN (44), ELYTRA (10), DACGLO (18)
Zone 6 (PCO-20)	West side slope above west infiltration basin	0.114	DACGLO (37.6), EPIBRA (30.2), CAPBUR (10), ACHMIL (10), BROMAR (5), POASEC (5), FESSAX (2), LACSER (0.2)
	Overall Average	0.085	

Notes:
mg/kg - milligrams per kilogram
Lab Qualifiers: J - Estimated value; U - Not detected above the Method Detection Limit
Vegetation samples collected July 17, 2018.

Grass Veg Code	Scientific Name	Common Name
BROMAR	*Bromus marginatus*	Mountain brome
DACGLO	*Dactylis glomerata*	Orchard grass
ELYLAN	*Elymus lanceolatus*	Thickspike w heatgrass
ELYTRA	*Elymus trachycaulus*	Slender w heatgrass
FESSAX	*Festuca saximontana*	Rocky Mtn fescue
POASEC	*Poa secunda*	Big bluegrass
TRIAESx SECCER	*Triticum aestivum x Secale cereal*	Sterile w heat

Forb Veg Code	Scientific Name	Common Name
ACHMIL	*Achillea millefolium*	Common yarrow
ANTCOT	*Anthemis cotula*	Stinking chamomile
CAPBUR	*Capsella bursa-pastoris*	Shepherd's purse
EPIBRA	*Epilobium brachycarpum*	Tall annual w illow herb
LACSER	*Lactuca serriola*	Prickly lettuce
LAPOCC	*Lappula occidentalis*	Flatspine stickw eed
MELOFF	*Melilotus officinalis*	Yellow sw eet clover
POLAVI	*Polygonum aviculare*	Prostrate knotw eed
RUMSPP	*Rumex* spp.	Dock
SANMIN	*Sanguisorba minor*	Small burnet

Table F-2
Vegetation/Ground Cover Estimates

Zone	Parameter	Bare Ground	Litter	Rock	Vegetation	Total
Zone 1	Sum	74	16	89	168	347
	Percentage	21%	5%	26%	48%	100%
Zone 2	Sum	194	0	83	57	334
	Percentage	58%	0%	25%	17%	100%
Zone 3	Sum	105	23	53	170	351
	Percentage	30%	7%	15%	48%	100%
Zone 4	Sum	64	55	52	182	353
	Percentage	18%	16%	15%	51%	100%
Zone 5	Sum	65	44	100	135	344
	Percentage	19%	13%	29%	39%	100%
Zone 6	Sum	20	15	221	78	334
	Percentage	6%	5%	66%	23%	100%

Notes:

Vegetation community/cover monitoring using the Point-Intercept Method was performed along two 165-foot transects within each zone. Observations were made every foot, for a total of 165 observation points per transect (a total of 330 observations per zone). Data from transects were summed for each zone.

One type of ground cover (bare ground, litter, rock, vegetation) was identified at each observation point.

If multiple vegetation species were encountered at an observation point, then each species was noted (and so the number of observations in a zone can exceed 330).

Vegetation community measurements collected July 17, 2018.

Table F-3
Vegetation Presence and Abundance - Seeded Species

Zone	Parameter	Total Number of Vegetation Encounters	Grasses										Forbs					Total Seeded Species	Seeded Grasses	Seeded Forbs
			BROMAR	DACGLO	ELYGLA	ELYLAN	ELYTRA	FESSAX	LEYCIN	PASSMI	POASEC	TRIAESx SECCER	ACHMIL	HELMUL	PENSTR	SANMIN	TRIREP			
Zone 1	Sum	168	5	39	0	72	11	7	0	0	1	0	3	1	3	2	0	144	135	9
	Percentage		3%	23%	0%	43%	7%	4%	0%	0%	1%	0%	2%	1%	2%	1%	0%	86%	94%	6%
	Presence		√	√		√	√	√			√		√	√	√	√		10	6	4
Zone 2	Sum	57	0	3	0	3	1	1	0	0	0	18	2	0	0	0	1	29	26	3
	Percentage		0%	5%	0%	5%	2%	2%	0%	0%	0%	32%	4%	0%	0%	0%	2%	51%	90%	10%
	Presence		√	√		√	√	√	√			√	√	√		√	√	11	7	4
Zone 3	Sum	170	16	62	5	1	0	32	0	13	5	0	8	0	8	13	0	163	134	29
	Percentage		9%	36%	3%	1%	0%	19%	0%	8%	3%	0%	5%	0%	5%	8%	0%	96%	82%	18%
	Presence		√	√	√	√		√		√	√		√	√	√	√		11	7	4
Zone 4	Sum	182	20	40	23	9	6	24	0	11	9	1	5	0	8	18	1	175	143	32
	Percentage		11%	22%	13%	5%	3%	13%	0%	6%	5%	1%	3%	0%	4%	10%	1%	96%	82%	18%
	Presence		√	√	√	√	√	√		√	√	√	√		√	√	√	13	9	4
Zone 5	Sum	135	7	47	0	55	11	4	0	1	1	0	8	0	0	0	1	135	126	9
	Percentage		5%	35%	0%	41%	8%	3%	0%	1%	1%	0%	6%	0%	0%	0%	1%	100%	93%	7%
	Presence		√	√		√	√	√		√	√		√			√	√	10	7	3
Zone 6	Sum	78	6	12	6	1	21	12	0	0	0	0	2	0	1	3	1	65	58	7
	Percentage		8%	15%	8%	1%	27%	15%	0%	0%	0%	0%	3%	0%	1%	4%	1%	83%	89%	11%
	Presence		√	√	√	√	√	√			√		√	√	√	√	√	12	7	5

Notes:

Vegetation community/cover monitoring using the Point-Intercept Method was performed along two 165-foot transects within each zone. Observations were made every foot, for a total of 165 observation points per transect (a total of 330 observations per zone). Data from transects were summed for each zone.

If multiple vegetation species were encountered at an observation point, then each species was noted (and so the number of observations in a zone can exceed 330).

Presence is indicated with a checkmark (√) for all species, including those species observed in the zone but not recorded at an observation point.

Two forb species (Arrowleaf balsamroot [*Balsamorhiza sagittata*] and Lewis flax [*Linum lewisii*]) were not seen during monitoring activities and are not listed on this table.

Vegetation community measurements collected July 17, 2018.

Grass Veg Code	Scientific Name	Common Name
BROMAR	*Bromus marginatus*	Mountain brome
DACGLO	*Dactylis glomerata*	Orchard grass
ELYGLA	*Elymus glaucus*	Blue wildrye
ELYLAN	*Elymus lanceolatus*	Thickspike wheatgrass
ELYTRA	*Elymus trachycaulus*	Slender wheatgrass
FESSAX	*Festuca saximontana*	Rocky Mtn fescue
LEYCIN	*Leymus cinereus*	Great Basin wildrye
PASSMI	*Pascopyrum smithii*	Western wheatgrass
POASEC	*Poa secunda*	Big bluegrass
TRIAESx SECCER	*Triticum aestivum x Secale cereal*	Sterile wheat

Forb Veg Code	Scientific Name	Common Name
ACHMIL	*Achillea millefolium*	Common yarrow
HELMUL	*Heliomeris multiflora*	Showy goldeneye
PENSTR	*Penstemon strictus*	Rocky Mountain penstemon
SANMIN	*Sanguisorba minor*	Small burnet
TRIREP	*Trifolium repens*	White clover

Table F-4
Vegetation Presence and Abundance - Non-Seeded Species

			Grasses	Forbs																					
Zone	Parameter	Total Number of Vegetation Encounters	BROSPP	ALYSPP	ANTCOT	CAPBUR	CARNUT	CHESPP	CIRARV	DESSOP	EPIBRA	LACSER	LAPOCC	MEDSAT	MELOFF	ONOVIC	PHAHAS	POLAVI	POLERE	RUMSPP	TRADUB	VERTHA	Total Non-Seeded Species	Non-Seeded Grasses	Non-Seeded Forbs
	Sum	168	2	0	0	0	0	0	0	0	7	3	0	0	0	0	0	2	7	0	3	0	24	2	22
	Percentage		1%	0%	0%	0%	0%	0%	0%	0%	4%	2%	0%	0%	0%	0%	0%	1%	4%	0%	2%	0%	14%	8%	92%
Zone 1	Presence		√	√		√	√			√	√	√	√		√	√	√	√	√		√		14	2	13
	Sum	57	0	0	0	0	0	0	0	0	3	0	1	0	1	0	0	23	0	0	0	0	28	0	28
	Percentage		0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	2%	0%	2%	0%	0%	40%	0%	0%	0%	0%	49%	0%	100%
Zone 2	Presence		√		√			√	√	√	√	√	√		√		√	√		√			12	1	11
	Sum	170	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	7	0	7
	Percentage		0%	0%	2%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	4%	0%	100%
Zone 3	Presence				√		√					√			√						√	√	6	0	6
	Sum	182	0	0	0	2	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	7	0	7
	Percentage		0%	0%	0%	1%	0%	0%	0%	0%	2%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	100%
Zone 4	Presence					√					√	√		√	√								5	0	5
	Sum	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Percentage		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Zone 5	Presence											√		√	√	√							4	0	4
	Sum	78	0	0	0	0	0	0	0	0	9	1	0	0	0	0	0	1	2	0	0	0	13	0	13
	Percentage		0%	0%	0%	0%	0%	0%	0%	0%	12%	1%	0%	0%	0%	0%	0%	1%	3%	0%	0%	0%	17%	0%	100%
Zone 6	Presence					√	√				√	√		√	√			√	√				8	0	8

Notes:

Vegetation community/cover monitoring using the Point-Intercept Method was performed along two 165-foot transects within each zone. Observations were made every foot, for a total of 165 observation points per transect (a total of 330 observations per zone). Data from transects were summed for each zone.

If multiple vegetation species were encountered at an observation point, then each species was noted (and so the number of observations in a zone can exceed 330).

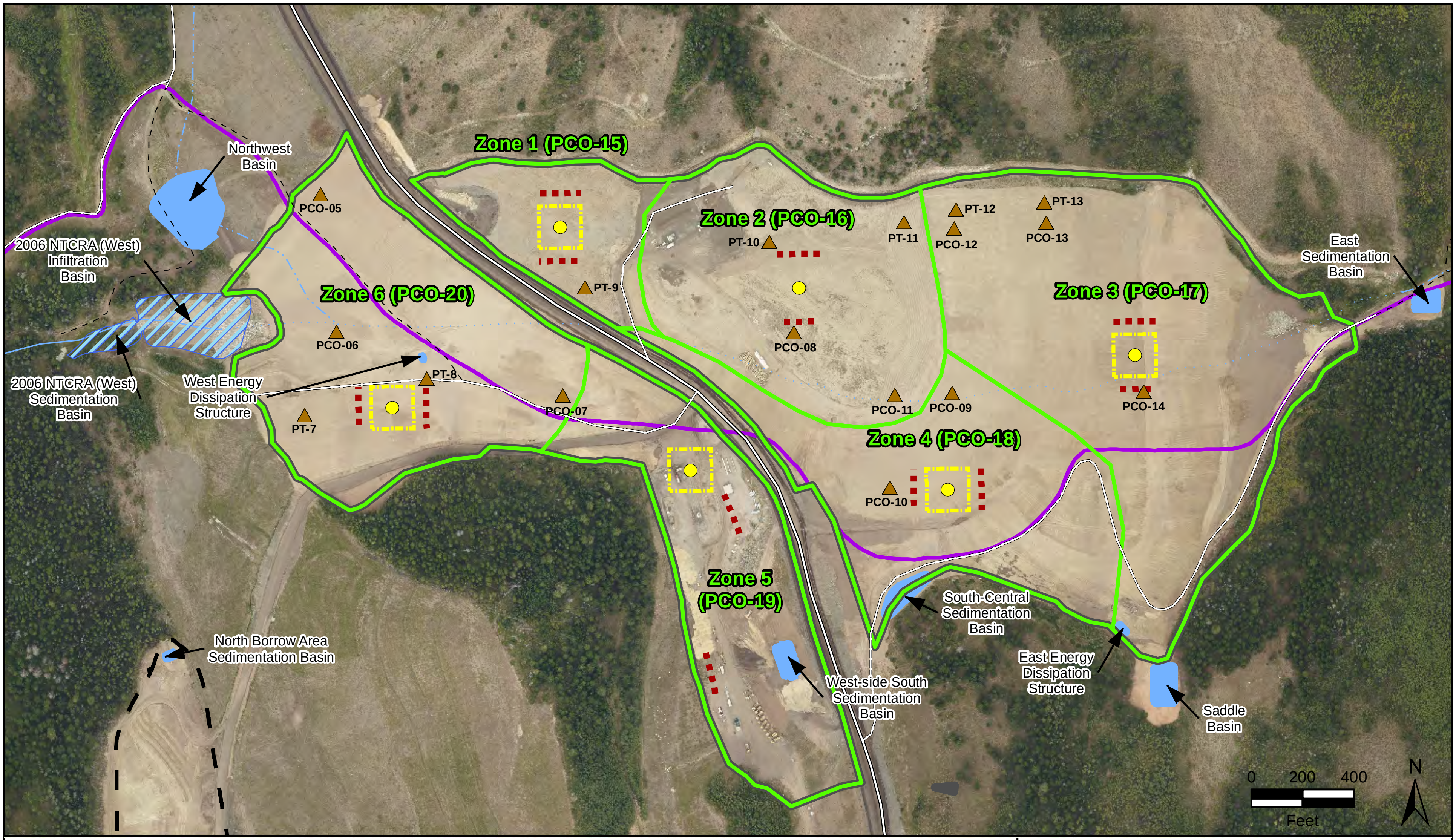
Presence is indicated with a checkmark (√) for all species, including those species observed in the zone but not recorded at an observation point.

This table includes species observed during step-point vegetation community monitoring, vegetation tissue sampling, or during general observations.This list should not be considered a comprehensive list of all species occurring in the area.

Vegetation community measurements collected July 17, 2018.

Grass Veg Code	Scientific Name	Common Name
BROSPP	*Bromus* spp.	Non-seeded Bromes (smooth brome, cheatgrass, etc.)

Forb Veg Code	Scientific Name	Common Name	Forb Veg Code	Scientific Name	Common Name
ALYSPP	*Alyssum* spp.	Madwort	MEDSAT	*Medicago sativa*	Alfalfa
ANTCOT	*Anthemis cotula*	Stinking chamomile	MELOFF	*Melilotus officinalis*	Yellow sweet clover
CAPBUR	*Capsella bursa-pastoris*	Shepherd's purse	ONOVIC	*Onobrychis viciifolia*	Sainfoin
CARNUT	*Carduus nutans*	Musk thistle	PHAHAS	*Phacelia hastata*	Silverleaf phacelia
CHESPP	*Chenopodium spp.*	Goosefoot	POLAVI	*Polygonum aviculare*	Prostrate knotweed
CIRARV	*Cirsium arvense*	Canada thistle	POLERE	*Polygonum erectum*	Erect knotweed
DESSOP	*Descurainia sophia*	Flixweed	RUMSPP	*Rumex spp.*	Dock
EPIBRA	*Epilobium brachycarpum*	Tall annual willow herb	TRADUB	*Tragopogon dubius*	Yellow salsify
LACSER	*Lactuca serriola*	Prickly lettuce	VERTHA	*Verbascum thapsus*	Common mullein
LAPOCC	*Lappula occidentalis*	Flatspine stickseed			



Legend

2006 NTCRA Basin Footprints	Pole Canyon ODA Cover Area Boundary
2013 NTCRA Basin Footprints	Vegetation Monitoring Zone
Pre-ODA Creek Flow Path	Vegetation Sampling Plot
Intermittent Stream	Vegetation Sampling Zone Centroid
Perennial Stream	Vegetation Monitoring Transect
2006 NTCRA Bypass Pipeline Alignment	Pre-NTCRA Vegetation Sampling Location
Dinwoody Borrow Area Boundary	

Primary Highway
Major Road
Minor Road
Unimproved Road
Trail (4WD)
Trail (Other than 4WD)

Notes:
NTCRA = Non-Time-Critical Removal Action

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SMOKY CANYON MINE
2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE F-1

VEGETATION EFFECTIVENESS MONITORING LOCATIONS - JULY 2018

DATE: JULY 2019
BY: RCR FOR: MKL

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2010109\plt\EffMonPlan_Pole_VgSampling_2018\PoleVeg_July2018_ApxF-1.mxd

"S:\JOBS\SMOKY\CERCLA\POLENTCRA\ANNRPT\2018\DRAFT\APPXFVEG\FIGAPPF2_BOXPLOT.PPTX"

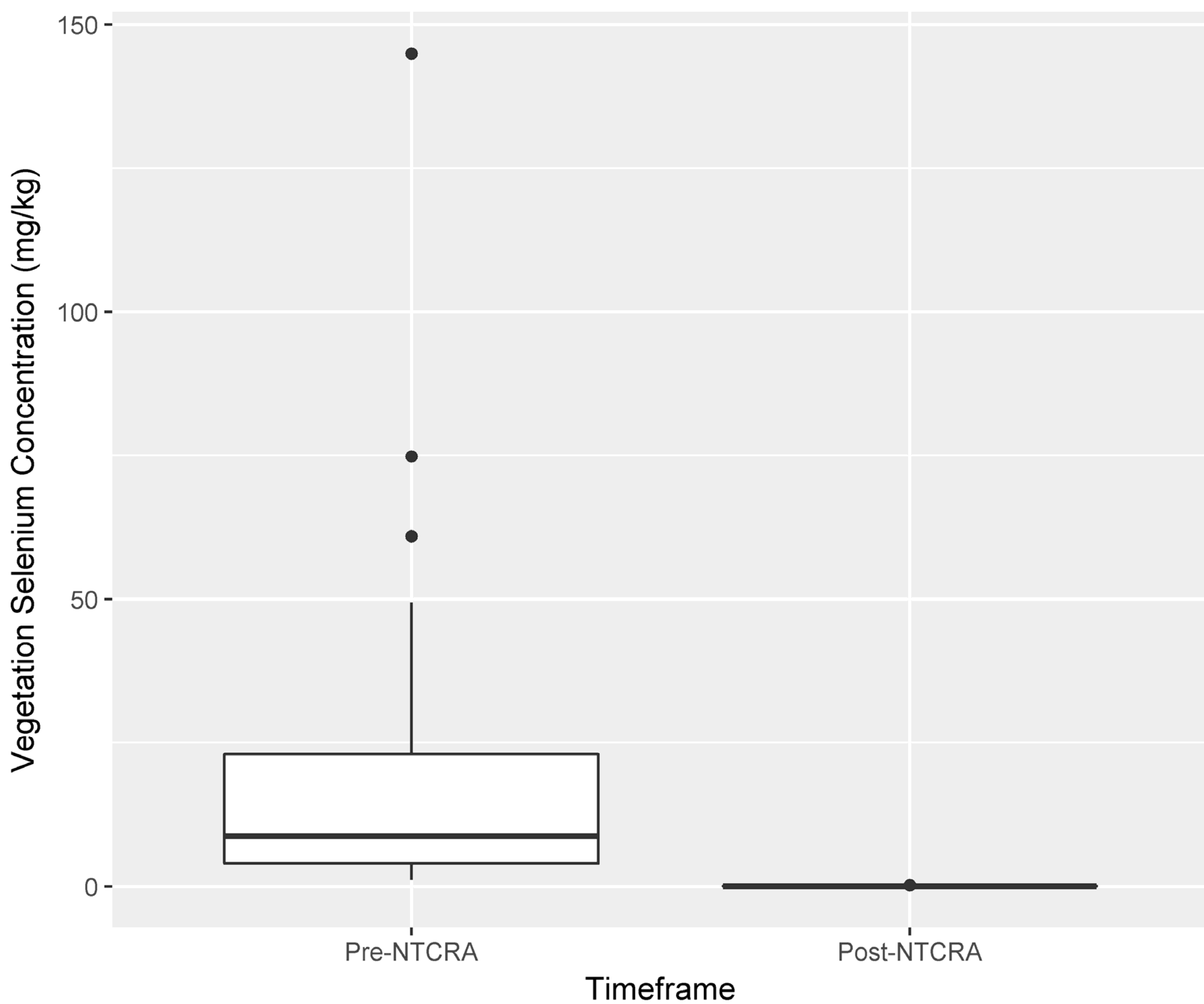

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FIGURE F-2

BOXPLOTS: PRE- AND POST-NTCRA VEGETATION SELENIUM CONCENTRATIONS

DATE: JULY 2019

BY: RCR | FOR: MKL

FORMATION ENVIRONMENTAL

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FIGURE F-3

REPRESENTATIVE VEGETATION CONDITIONS IN ZONE 1 – JULY 2018

DATE: JULY 2019		FORMATION ENVIRONMENTAL
BY: RCR	FOR: MKL	

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FIGURE F-4

REPRESENTATIVE VEGETATION CONDITIONS IN ZONE 2 – JULY 2018

DATE: JULY 2019		FORMATION ENVIRONMENTAL
BY: RCR	FOR: MKL	

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FIGURE F-5

REPRESENTATIVE VEGETATION CONDITIONS IN ZONE 3 – JULY 2018

DATE: JULY 2019

BY: RCR | FOR: ACK

FORMATION ENVIRONMENTAL

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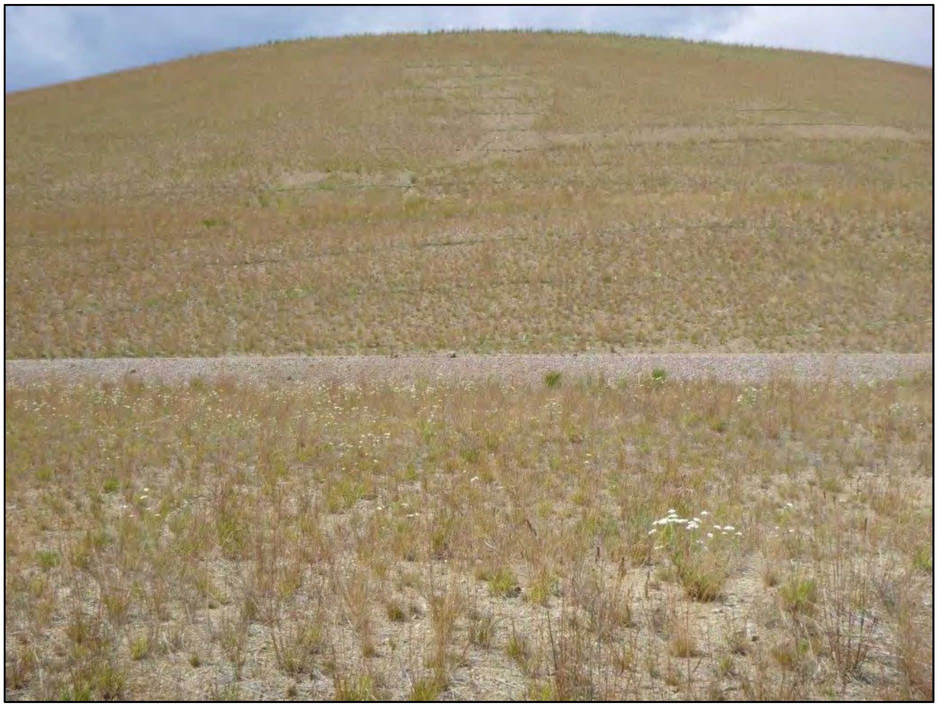

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FIGURE F-6

REPRESENTATIVE VEGETATION CONDITIONS IN ZONE 4 – JULY 2018

DATE: JULY 2019

BY: RCR | FOR: ACK

FORMATION ENVIRONMENTAL

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FIGURE F-7

REPRESENTATIVE VEGETATION CONDITIONS IN ZONE 5 – JULY 2018

DATE: JULY 2019		FORMATION ENVIRONMENTAL
BY: RCR	FOR: ACK	

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2018 PERFORMANCE AND EFFECTIVENESS MONITORING REPORT

FIGURE F-8

REPRESENTATIVE VEGETATION CONDITIONS IN ZONE 6 – JULY 2018

DATE: JULY 2019
BY: RCR | FOR: ACK

FORMATION ENVIRONMENTAL